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NOTES ON NORTH AMERICAN SPHAGNUM. X. REVIEW

A. LEROY ANDREWS[1]

Some years ago in contributing an account of the Sphagnaceae to the *North American Flora*,[2] which by the plan of that work was restricted to technical descriptions with keys, synonymy and distribution, I began a series of supplementary notes in *The Bryologist*.[3] The notes were broken off before completion, partly because of other work, partly because the next species in order would be *S. subsecundum*, which is a critical species deserving further study. But before resuming with a discussion of this species I wish to bring my earlier publications up to date by a few changes and some reassertions of viewpoint. This is particularly in order as I understand a revised list of North American (north of Mexico) bryophytes is contemplated for the near future. The species inflation of Warnstorf has now been generally reduced, and there is at any rate a fair degree of concensus as to the species common to Europe and North America and Japanese bryologists are now finding that most of the same species are represented in Japan, that is, extend through a complete circumboreal range. There remain however a few differences of species concept or of nomenclature between European and American bryologists, even in some cases among bryologists of different European countries. This has naturally led to bewilderment on the part of some non-specialists,[4] and it is partly to dissipate this that I contribute the

[1] 409 Mitchell St., Ithaca, N. Y.

[2] North American Flora 15: 3-31. 1913. N. Y. Botanical Garden.

[3] Bryologist 14: 72 (1911) and at intervals through 24: 86 (1922).

[4] Not very long ago a contributor to *The Bryologist* who had sent *Sphagnum* specimens to both European and American bryologists for determination was able to add considerably to his score of findings by thus doubling several species.

following notes. The order followed is that of my former publications beginning with the subgenus Inophloea, and I include a couple changes of name of non-American species treated in my "Notes on the Warnstorf Sphagnum Herbarium."[5]

1. *Sphagnum centrale* C. Jens. For the re-instatement of this as an independent species see my notes on the Subgenus Inophloea in the Eastern Hemisphere.[6]

2. *Sphagnum leionotum* C.M. This name for a species of Australia and New Zealand closely related to the preceding is antedated by *S. cristatum* Hampe published in 1874[7] and should then be replaced by the latter name. The credit for discovering and publishing the facts belongs to Mr. J. H. Willis of the National Herbarium of Victoria, Australia, who found the type and recognized its identity.[8] Warnstorf had been misled by a specimen so named, not the type, to place it in synonymy under an entirely wrong and unrelated species. The type was in good condition and even fruiting.

3. *Sphagnum antarcticum* Mitten. Willis has also shown[9] that this name is antedated and should be replaced by *S. australe* Mitt. *ex* Wilson. Warnstorf had mistaken publishing dates. The mistakes are corrected by Willis, who calls attention to the fact that the *Flora Tasmaniae* was published in parts, the part including the Bryophyta appearing in 1858, complete bound volumes bearing only the final date 1860 which is the date generally cited. The late Mr. G. O. K. Sainsbury in his admirable "Handbook of the New Zealand Mosses"[10] was fortunately able to incorporate both these corrections of Willis'.

4. *Sphagnum lenense* H. Lindberg. This name has recently appeared in lists of species from Alaska and Greenland by European botanists. It has never been published as far as I can discover, but was known as an unpublished name (in litt. 1903) already by Warnstorf (1911), who included it under his var. *microphyllum* of *S. Lindbergii*. It is in fact a small form of the latter species. If one compares this small arctic form with the more normal form it is easy to gain the impression that one is dealing with two quite distinct species. But after examining a number of specimens and finding all degrees of intergradation (varieties *macrophyllum*,

[5] Annales Bryologici 9: 3-12 (1937) and continued in *The Bryologist* at intervals from 1941-1951. See also Ann. Bryol. 6: 1-6 (1933) and 11: 15-20 (1938).
[6] Bryologist 54: 83. 1951.
[7] Linnaea 38: 661. 1874.
[8] The Victorian Naturalist 70: 55. 1953.
[9] *Op. cit.* p. 56. 1953.
[10] Roy. Soc. N.Z. Bull. No. 5. 1955.

mesophyllum and *microphyllum* of Warnstorf) and finding no especial points of difference apart from the size, one is forced to agree with Warnstorf, who was certainly no conservative in his delimitation of species, that it is at most a small-leaved variety that is involved. It is doubtless desirable to emphasize its value as a taxonomic variety as it is easy on superficial examination to confuse it with *S. fuscum* which often grows in the same places, but the two are quite different in microscopic characters, belonging even to different sections. The name *lenense* is obviously derived from the Lena River in Siberia, but Arnell in his "Zur Moosflora des Lenatales"[11] included the form as *S. Lindbergii* var. *microphyllum* without reference to the unpublished name of H. Lindberg, though one of his two localities was furnished by information from H. Lindberg.[12] It is the arctic form of the species, which also otherwise varies greatly in external aspect according to the conditions of its habitat. It is in America not confined to Greenland and Alaska, but I have also several specimens from northeastern Canada collected by Lepage and others. As the form is now under discussion it may be worth-while to list these collections of the strictly microphyllous form. At the outset it should be said that the fruiting specimen distributed as No. 80 of the *Sphagna Boreali-Americana Exsiccata* of Eaton and Faxon collected by Waghorne at Pinware River, Labrador, labeled *S. Lindbergii* var. *microphyllum*, is not this form, but at most a slight approach to it (var. *mesophyllum*). But the following are clear cases of the var. *microphyllum* from the Canadian North: a. *J. Rousseau*, Rivière Payne, vers 60° lat. N., Ungava occidental, Québec, 1948. This was sent me already named *S. Lindbergii* by James Kucyniak. b. *E. Lepage*, Golfe de Richmond, lat. 56° 10′, Québec, 1944. c. *J. D. Soper*, Cumberland Sound, Baffin Island, 1924. Other specimens approach it in various degrees and ways. The branch leaves of the small form are sometimes arranged conspicuously in five ranks, but this is not always the case and can sometimes be observed also in the larger forms. I note that already in my 1913 description, drawn up from large forms, there is reference to the leaves when moist tending to be in five ranks.

5. *Sphagnum recurvum* Beauv. This well established early species one finds currently replaced, at any rate on the part of some Scandinavian bryologists, by two names: *S. apiculatum* H. Lindb. and *S. amblyphyllum* (Russ.) H. Lindb., the name *S. recurvum* then often disappearing entirely. I find no particular

[11] Ark. f. Bot. 13(2): 26. 1913.
[12] The *Sphagna* for Arnell's paper were determined by C. Jensen.

difference between the two, the only point emphasized being a minor and inconstant difference of stem leaves (sometimes found on the same stem) and I see no reason to alter my judgment expressed in *The Bryologist* (20: 86. 1917) that the forms, if forms they be, are not even worthy of varietal distinction. *S. recurvum* is a clearly distinct species of wide distribution in the world.

The small form of *S. recurvum* also appears in Scandinavian and other European lists as an independent species, either named *S. angustifolium* C. Jens. or *S. parvifolium* (Sendtn.) Warnst. This I have treated as *S. recurvum* var. *tenue* H. Klinggr., the earliest varietal name for it. My reason for regarding it as variety rather than species is its lack of distinguishing characters other than size and the observation constantly confirmed in the naming of many specimens that there is no satisfactory point where one can draw an absolute line between species and variety. I have tried in practice to limit the variety to specimens with branch leaves so small that when dry they show no undulations, but only the recurved tip, but even in this case one sometimes finds both in the same tuft. However I feel that the variety should have taxonomic sanction as it can easily be mistaken as not belonging to *S. recurvum* and like the small form of *S. Lindbergii* it is of more limited northern distribution than the more typical larger form, in this case however only circumboreal, not arctic or subarctic.

6. *Sphagnum macrophyllum* Bernh. Blomquist and Rogers[13] have emphasized the varietal status of var. *floridanum* Aust.

7. *Sphagnum Warnstorfii* Russ. It has long been recognized that this name is antedated by an earlier invalid *S. Warnstorfii* of Röll, but no one has wished to deprive Warnstorf of a species dedicated to him. Recently DuRietz[14] has suggested a change to *Warnstorfianum*, which is perhaps the best solution of the difficulty. No one questions the validity of the species as distinguished by Russow and one regrets denying him the credit for recognizing it and dedicating it to Warnstorf.

8. *Sphagnum capillaceum* (Weiss) Schrank. This basic species of the Acutifolia group, formerly generally known as *S. acutifolium* Ehrh., appears now in recent lists of Scandinavian bryologists as *S. nemoreum* Scop. This name is older than either of the others, but the description is not adequate for identification, and as far as I am aware no material of it has been preserved. Evidence as to

[13] Bryologist 54: 95ff. 1951.
[14] Svensk Bot. Tidskr. 39: 151. 1945.

its identity adduced by S. O. Lindberg and K. F. Dusén is highly circumstantial and unconvincing, for example, the point that *S. Girgensohnii* doesn't often fruit. On the other hand the name *capillaceum* rests at least in part on specimens preserved in the Dillenian Herbarium, and Miss Jane Taylor of the Kew Herbarium, who devoted a note to confirmation of the name *capillaceum*,[15] took the trouble to look up the Dillenian specimens. In selecting the name I had the editorial co-operation of Dr. J. H. Barnhart, whose knowledge of botanical bibliography was profound, and I am convinced that *S. capillaceum* is a more substantially based name than *S. nemoreum*.

9. *Sphagnum capillaceum* var. *tenellum* (Schimp.) Andr. This appears regularly in European literature as *S. rubellum* Wils. and with some reason. It certainly deserves taxonomic recognition of some sort. My reason for regarding it as a variety is that at any rate in American specimens all its characters show such intergradation with more typical *S. capillaceum* that often the placing of a specimen is a somewhat arbitrary choice.

10. *Sphagnum plumulosum* var. *flavicomans* (Card.) Andr. There has been uncertainty as to whether this is to be regarded as a species or variety. It was first described by Cardot as a variety of *S. acutifolium*. Warnstorf recognized a greater similarity with *S. subnitens* Russ. & Warnst. (= *S. plumulosum* Röll). Later (1911) he treated it as an independent species. This latter standpoint was confirmed by a monograph by Hugo Osvald,[16] who had studied it extensively in American coastal bogs. I now think that the concept of it as an independent species is correct and that I was wrong in associating it too closely with *S. plumulosum*, though relationship with the latter can hardly be denied. Some specimens collected recently by Mr. Roy Latham on Long Island, New York State, which are not as characteristically developed as usual, are not very suggestive of *S. plumulosum*, apart from size, and look more like unusually large green, slightly brownish specimens of *S. capillaceum*. As *S. flavicomans* (Card.) Warnst. it is confined to our coastal region from New Jersey north to Newfoundland, reports from farther north being doubtful as noted by Sjörs.[17]

11. *Sphagnum subfulvum* Sjörs. This was proposed as a species by H. Sjörs in 1944[18] and was based upon numerous, mostly Swedish specimens, which would normally be regarded as dark

[15] Extracted as Kew Bulletin No. 2, p. 277. 1953.
[16] Acta Phytographica Suecica 13: 39ff. 1940.
[17] See the next entry. [18] Svensk Bot. Tidskr. 38: 403ff. 1944.

brownish purple specimens of *S. plumulosum* Röll, somewhat suggestive of *S. flavicomans*, but clearly distinct from it. Through the kindness of Dr. H. Persson I have two authentic Swedish specimens, duplicates of specimens listed by Sjörs, which give a clearer idea than the detailed description and illustrations. As to its American occurrence the author was able to give no definite statement apart from correcting the status of Berggren's Greenland collections which had previously been referred to *S. flavicomans*. He suspected its further presence in arctic or subarctic regions of America, and in the separate reprint which he sent me he had written in the statement that it had "recently been found on Newfoundland and E of Hudson Bay by R. Tuomikoski." In the American material at present accessible to me there is a single specimen in the Cornell University (Wiegand) Herbarium referable to Sjörs' species, collected by Waghorne in 1895 at the Bay of Islands, Newfoundland. It was named by Warnstorf *S. subnitens* var. *obscurum*, which would normally represent *S. flavicomans*. Aside from the Greenland and Scandinavian localities Sjörs lists a few other European ones including even one in Switzerland. He represents it as rather abundant and widespread in Sweden, but in a large number of unnamed specimens from all parts of Sweden sent me for naming by Persson I found not a single collection referable to this form, though there were several of *S. plumulosum*. Many years ago the Rev. D. Lillie of Scotland sent me a very large number of *Sphagnum* specimens from northern Scotland, mostly from Caithness, a very few from East and West Sutherland and some from the Orkney and Shetland Islands. A large number of these I had identified as *S. plumulosum*, the species being much more common in Europe than in America. Some of these are dark purplish brown and might suggest Sjörs' species, but they are connected by all gradations with the more normal type. With the best intentions and diligent use of Sjörs' article I am frankly unable to determine which, if any, represent his species. Sjörs' efforts to bring out the differences, which are slight at best, though praiseworthy, are confusing rather than clarifying in their effects. The denial of a purplish color in *S. subfulvum* is puzzling, the author explaining it as "metallic lustre" only. One is also surprised by the statement that *S. plumulosum* when relieved of *S. subfulvum* is a species without appreciable variation. My experience with it would rather suggest great variation, which for that matter corresponds with the experience of Warnstorf, who endows it with a considerable number of varieties and forms including for example

vars. *purpureum* and *ochraceum*. My experience with Sjörs' form is at present too limited to express more than frank skepticism of its separation from *S. plumulosum*. If, I get that far I will later discuss more at length the latter species.

12. *Sphagnum tenerum* Sull. & Lesq. This is at best an unsatisfactory species. I include it here because of the long dispute as to whether it occurs at all in Europe. I occasionally receive letters and specimens from parts of Europe as persons think they have found it, but I have not yet seen a European specimen that I would identify as this species. Warnstorf's listing of various European countries for it is explained by the fact that he finally came to a complete misconception of what it was. Lately a Danish botanist[19] has devoted an article to *S. tenerum* Sull. & Lesq. "and *S. tenerum* (Aust.) Warnst." in which she refers several Danish collections to this American species. I have not seen her specimens, but her illustrations are not dissimilar. She has passed rather lightly over my publications, stating that I cited certain specimens of Warnstorf that I can't find that I did cite and disagreeing with my determination of the majority of the specimens that I did cite. Furthermore she ignored entirely my discussion of *S. tenerum* in the *Annales Bryologici* (6: 4-6. 1933) from which she might at any rate have learned that there is no "*S. tenerum* of Austin," Warnstorf having misread the handwritten "near tenerum" on the Austin packet as var. *tenerum*. The specimen in question, which Mrs. Lange had not seen, but which she nevertheless conjectured must be the same as the Sullivant and Lesquereux species, I had, rightly or wrongly, determined as *S. meridense* Hampe. I find similar misunderstanding of *S. tenerum* on the part of American bryologists who sometimes report it from localities which seem to me outside its range. The range as I understand it is the Atlantic coastal one common to a number of our American species, in this case extending from Alabama north to Newfoundland, inland to Tennessee, to which I have hesitatingly added eastern South America.[20] The North American range comprises areas where the more typical *S. capillaceum* is less or not likely to occur. Difficulty in identification rests especially upon the difficulty of giving a readily tangible diagnostic character. I have been obliged to limit the points of difference to the obese branches with very imbricate leaves which show an especially lax areolation with the empty cells (leucocytes) showing very strong convexity on the dorsal surface. This I will

[19] B. Lange, Bot. Tidskr. 52: 43 ff. 1955.
[20] Bryologist 50: 184. 1947.

freely admit is not very satisfactory and while for the present disposed to maintain the species, I have no quarrel with anyone preferring to regard it as a variety of *S. capillaceum* and can at any rate understand the contention that it should be merged in this species. In the Acutifolia group *S. capillaceum* represents a still somewhat variable central mass from which other species have been separated in various directions. Many of these are now reasonably clear, some, including *S. tenerum*, are less so. I hope to attempt to clarify somewhat these relationships if I can first finish the Cuspidata group. With reference to *S. tenerum* it should be added that Mrs. Virginia S. Bryan in her admirable cytological study of several *Sphagnum* species[21] reported for this species a greater number of accessory or m-chromosomes than in other species studied. However in view of present lack of knowledge about these m-chromosomes I would not stress this point as of necessary taxonomic significance.

13. *Sphagnum tabulare* Sull. Instead of this name European bryologists generally use *S. molle* Sull. Both were published at the same time, *S. tabulare* having page priority, application of which was regular practice at the New York Botanical Garden when my monograph was published. This practice seems reasonable if the principale of priority is to be applied at all.

[21] Bryologist 58: 16ff., especially 34-38. 1955.

TRIANDROPHYLLUM, A NEW GENUS OF LEAFY HEPATICAE

MARGARET FULFORD and RAYMOND E. HATCHER[1]

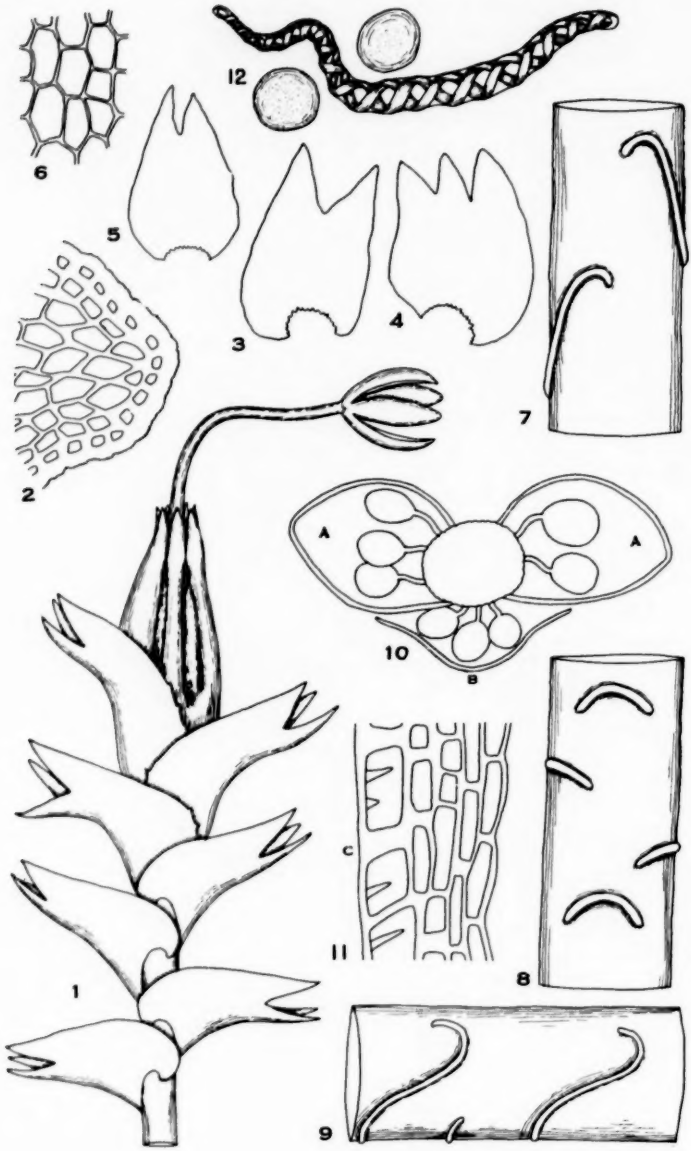
In the course of a taxonomic study of South American leafy Hepaticae,[2] several species presently recognized under at least five genera have been found to form a homogeneous unit of generic rank which is distinct from the genera to which they are now assigned. These species are characterized by an upright to ascending habit, branches which are almost exclusively ventral and intercalary, leaves which are incubous and bifid to trifid and a male inflorescence in which antheridia are developed in the axils of both bracts and bracteoles.

[1] Dept. of Biological Sciences, University of Cincinnati, Cincinnati 21, Ohio.

[2] From work related to a project supported by a National Science Foundation Grant (G 2616).

Triandrophyllum gen. nov. Planta pallide virens vel subrufescens, caespitosa, terricola. Caulis ad 6 cm. longus, parum ramosus, ramosis ventralibus ex axillis amphigastriorum. Folia caulina conferta, decurvata, concava, in plano ovata, subsymmetrica, incuba, antice plus minus ampliata, postice brevissime inserta, apice ad ⅓ bi- trifida, lobis triangularibus, magnitudine subparilibus, cellulis angulato-rectangulario, cuticulbus laeve. Amphigastria caulina recurvata, ovato-triangulares, symmetrica, ad ⅓ bi- trifida, lobis ut in foliis. Dioica. Folia floralia eis caulinis similia sed majora. Perianthia oblonga, 3- vel 5-plicata, unistrata, ore constricta, ad ½ divisa, laciniis longe lanceolatis, denticulatis, canaliculatis, archegonia 18-25, calyptra libra, capsula obovata, quadrivalvis. Sporae parvae, asperae. Elateres bispiri.

Plants in tufts or mats, erect to ascending, reddish to brownish-green, stem apices usually decurved, stems simple or irregularly branched, branches mostly ventral, intercalary, or very rarely pinnately branched with branches of the *Frullania* type, ventral branches arising in the axils of underleaves, mostly leafy, sometimes flagelliform with reduced, scale-like leaves and underleaves; stem oval to orbicular in cross-section, 12-16 cells in diameter, cells of the medulla angular, thin-walled, those of the cortex smaller, with thicker walls, in 1-2 layers, with a thickened, striolate-papillose cuticle; rhizoids present on flagelliform branches, clustered, colorless; leaves distant to imbricate, incubous, more or less falcate, asymmetric, obliquely inserted, the insertion curving downward near the dorsal margin, forming a short hook, apex of the leaf divided to about ⅓ into 2-3 acute, unequal to subequal triangular segments, the dorsal segment the largest, the sinus acute to obtuse, the dorsal margin of the leaf strongly convex from a rounded to cordate base, entire or with an occasional tooth, the ventral margin straight from a rounded or straight base, entire to dentate to spinose particularly near the base, the lamina usually slightly concave, often more or less cordate on one or both sides; cells small, rounded-quadrate to rectangular, walls uniformly thin, trigones inconspicuous, the cuticle smooth; underleaves similar to the leaves, slightly smaller, symmetric. Dioicous; male inflorescence terminal or intercalary on a main stem or branch, bracts and bracteoles in usually eight or more series, similar to the leaves and underleaves, but slightly larger, the lamina with a strong median abaxial bulge; antheridia 2-3 in the axils of both bracts and bracteoles, large, globose, the stalk of two or more rows of cells; female inflorescence erect, terminal on a main stem or branch, bracts and bracteoles similar, in 2-3 series, similar to the leaves but more strongly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dentate, forming a transitional sequence from the leaves to the innermost and largest series; perianth oblong, 3-5-plicate, contracted to the mouth, the mouth dissected into 6-9 triangular, entire, dentate or spinose segments; capsule ovoid, dark reddish-brown, dehiscing to the base into four valves, capsule wall of 4-5 layers of cells, the outer layer of large cells with thickened radial bars, the inner layers of smaller cells, with both radial and tangential thickenings. Spores orbicular, brown, very minutely punctate; elaters long, tapering, bispiral to the tips.

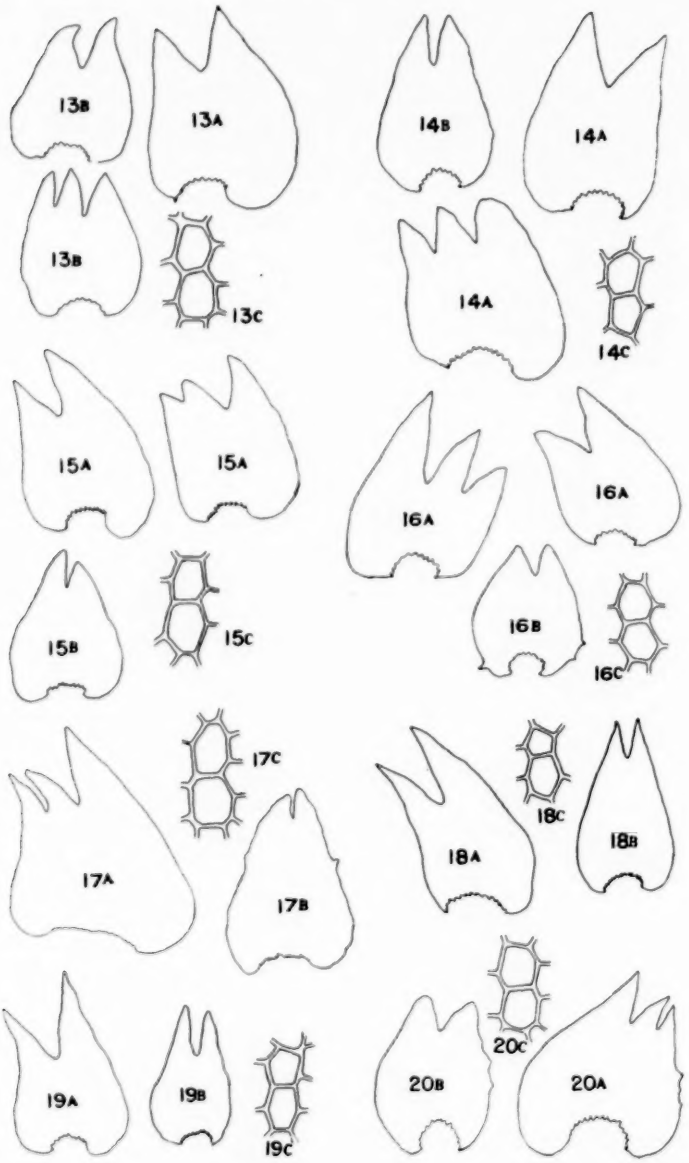
Triandrophyllum subtrifidum (Hook. & Tayl.) comb. nov. *Jungermannia subtrifida* Hook. & Tayl. London Jour. Bot. 3: 579. 1844. *Isotachis subtrifida* (Hook. & Tayl.) Mitt. *in* Hooker's Bot. Antarct. Voy. II. 2: 148. 1855. *Isotachis ripensis* Spruce. Trans. & Proc. Bot. Soc. Edinburg 15: 339. 1885. *Isotachis anceps* Mass. Nuov. Giorn. Bot. Ital. 17: 201. 1885. *Isotachis Nordenskjöldii* St. Sp. Hep. 3: 659. 1909. *Isotachis Halleana* St. K. Svenska Vet.-Akad. Handl. 46(9): 69. 1911. *Isotachis lanciloba* St. *op. cit.* p. 70. *Isotachis heterophylla* St. Sp. Hep. 6: 354. 1924. *Isotachis mutabilis* Herz. Arch. Escuela de Farm. Fac. Cienc. Med. Cordoba 7: 26. 1938.

This species may be distinguished by the following characters: leaves approximate to imbricate, spreading, often curved toward the ventral side, bifid to trifid, with the sinus extending to one half the length of the leaf, the segments triangular, acute to obtuse or occasionally rounded, margins of both leaves and underleaves entire or occasionally with one or a few short teeth. FIG. 1-20.

DISTRIBUTION IN SOUTH AMERICA: Bolivia, Ecuador, Chile, Patagonia, Fuegia, and the Falkland Islands.

Triandrophyllum durum (St.) comb. nov. *Herberta dura* St. Hedwigia 34: 44. 1895. *Schisma dura* St. Sp. Hep. 4: 21. 1909. *Isotachis appendiculata* St. Sp. Hep. 3: 659. 1909. *Lepicolea boliviensis* St. Sp. Hep. 6: 362. 1924.

FIG. 1-12. *Triandrophyllum subtrifidum.* 1. Portion of a stem, dorsal view, showing perianth and mature sporophyte, × 10. 2. Portion of the cross-section of a stem, × 180. 3, 4. Stem leaves, × 10. 5. Stem underleaf, × 10. 6. Cells from the median portion of a leaf, × 180. 7-9. Diagrams of a portion of a stem showing the line of insertion of leaves and underleaves (7, dorsal view; 8, ventral view; 9, lateral view), × 40. 10. Diagram of a cross-section of a male inflorescence showing position and number of antheridia in the axils of bracts (*A*) and bracteole (*B*), × 30. 11. Portion of a cross-section of a capsule valve (*C*, outer or exposed surface), × 360. 12. Elater and two spores, × 360. Figures 1 and 7-12 were drawn from material collected by Jameson in Quito, Ecuador (BM). Figs. 2-6 drawn from a portion of the original material of *Jungermannia subtrifida* from Australia (K).


13B
13A
13B
13C
14B
14A
14A
14C
15A
15A
15B
15C
16A
16A
16B
16C
17C
17A
17B
18C
18A
18B
19A
19B
19C
20C
20B
20A

This species may be distinguished by the following characters: leaves approximate to imbricate, spreading, sometimes curved toward the ventral side, bifid to trifid with the sinus extending from one half to two thirds the length of the leaf, the segments triangular to lanceolate, acute, margins of the underleaves and usually the ventral margin of the leaves spinose. FIG. 21-25.

DISTRIBUTION IN SOUTH AMERICA: Bolivia, Patagonia, and Fuegia.

Triandrophyllum antarcticum (St.) comb. nov. *Mastigophora antarctica* St. K. Svenska Vet.-Akad. Handl. Bih. 26(6): 56. 1900. *Herpocladium antarcticum* St. K. Svenska Vet.-Akad. Handl. 46(9): 66. 1911. *Isotachis georgiensis* St. Schwed. Subpolar Exped. 4(1): 4. 1905.

This species may be distinguished by the following characters: plants small, leaves distant to approximate, spreading to slightly appressed, bifid, the sinus extending to one half the length of the leaf, the segments triangular, margins of leaves and underleaves entire or with a few small teeth near the base. FIG. 26-29.

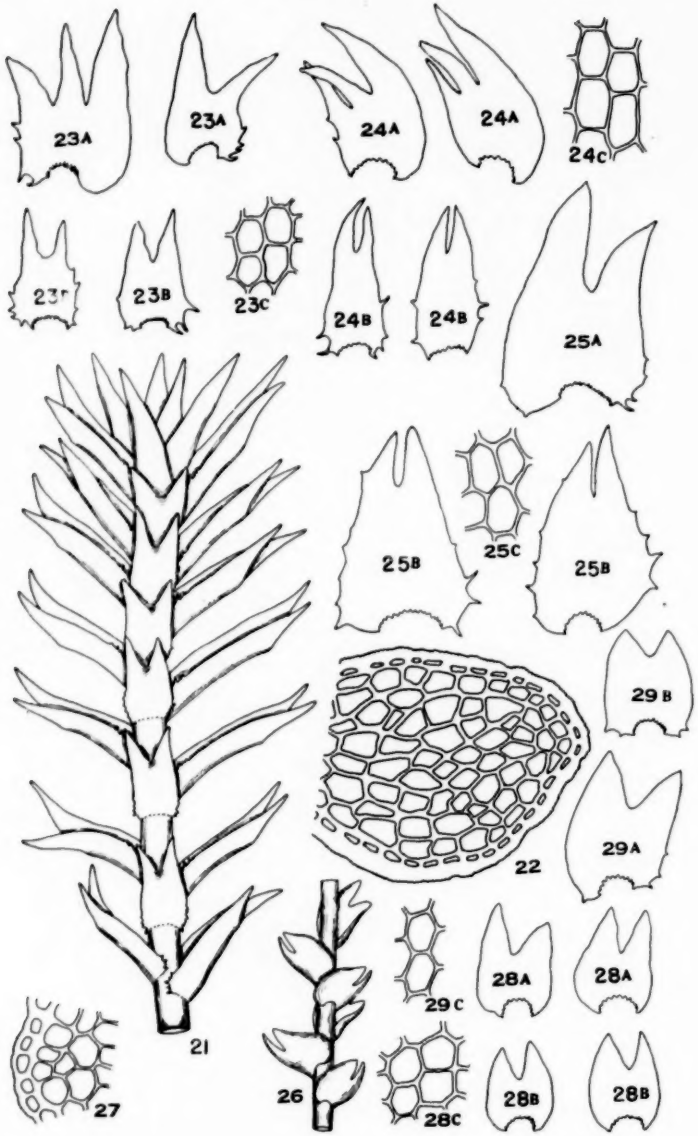
DISTRIBUTION IN SOUTH AMERICA: South Georgia.

Most of the species of *Triandrophyllum* were originally described under the generic name *Isotachis*. They are, however, distinguished from *Isotachis* by the fact that they possess a well-developed perianth, whereas *Isotachis* lacks a perianth, developing instead a thick, tubular perigynium.

Triandrophyllum differs from *Lepicolea* in that, in the latter genus, a fleshy, club-shaped coelocaule is developed, and as in *Isotachis*, a perianth is absent.

The species of *Triandrophyllum* may be distinguished from *Mastigophora* by their branching habit which is almost exclusively ventral and intercalary. Branching in *Mastigophora* is lateral, of the *Frullania* type, with the branches arising from the ventral half of a leaf initial and, consequently, an incomplete subtending leaf is formed. Thus far, no ventral branches have been observed

FIG. 13-20. *Triandrophyllum subtrifidum*—showing the leaf (*A*), × 10; underleaf (*B*), × 10 and cells from the median portion of the leaf (*C*), × 180, from the original material of the following: 13. *Isotachis halleana* St., collected by Halle in Fuegia (G). 14. *Isotachis subtrifida* (Hook. & Tayl.) Mitt., collected by Hooker in Australia (K). 15. *Isotachis nordenskjöldii* St., collected by Nordenskjöld in Patagonia (G). 16. *Isotachis mutabilis* Herz., collected by Hosseus in Chile (in herb. Herzog). 17. *Isotachis ripensis* Spruce, collected by Spruce in Ecuador (NY). 18. *Isotachis anceps* Mass., collected by Spegazzini in Fuegia (VER). 19. *Isotachis lanciloba* St., collected by Skottsberg in the Falkland Islands (G). 20. *Isotachis heterophylla* St., collected by Herzog in Bolivia (G).


23A
23A
24A
24A
24C
23B
23C
24B
24B
25A
25B
25C
25B
29B
29A
22
21
27
26
29C
28A
28A
28C
28B
28B

in *Mastigophora*. Furthermore, in the latter genus, the female bracts of the innermost series are coalesced longitudinally at one or more points with the surface of the perianth. In *Triandrophyllum*, the bracts are free from the perianth.

While the species of *Triandrophyllum* show definite affinities with the genus *Herberta*, they may be distinguished from the latter by the absence of a vitta which is so conspicuously developed in the leaves of *Herberta*.

A comparison of *Triandrophyllum* with the type species of the genus *Herpocladium*, *H. gracile* (Mont.) St., indicates a very close relationship between these two genera. The growth form, habit of branching, shape and insertion of leaves and underleaves, and both male and female inflorescences are similar. The two genera may be separated, however, by the character of their leaf and stem cells. The leaf cells of *Herpocladium gracile* are irregularly rectangular in the median portion of the lamina and have strongly thickened secondary walls with distinct pits formed between adjacent cells. The leaf cells of *Triandrophyllum* are also irregularly rectangular, but their walls are thin and devoid of pits. The stem cells of *H. gracile* have 2-3 layers of cortical cells in which the secondary wall thickening has progressed to such an extent that the cell lumen is nearly obliterated; the medullary cells are also strongly thickened and, like the leaf cells, show well developed pits in the secondary walls. Cortical cells in the species of *Triandrophyllum* are in 1-2 layers and show considerably less thickening of the walls than in *Herpocladium;* the medullary cells are thin-walled and lack pits in the secondary walls. In addition, the two genera show a distinctive difference in leaf shape. The leaves of *H. gracile* are bifid, with the sinus so narrow that the inner margins of the segments are parallel and sometimes even

FIG. 21-25. *Triandrophyllum durum*. 21. Portion of a leafy stem, ventral view, × 10. 22. Cross-section of a portion of a stem, × 180. 23-25. Leaf (*A*), × 10, underleaf (*B*), × 10, and median cells of the leaf (*C*), × 180, from the original material of the following: 23. *Isotachis appendiculata* St., collected by Dusén in Patagonia (G). 24. *Lepicolea boliviensis* St., collected by Herzog in Bolivia (G). 25. *Herberta dura* St., collected by Dusén in Fuegia (G). Figures 21 and 22 were drawn from a portion of the original collection of *Isotachis appendiculata*. FIG. 26-29. *Triandrophyllum antarcticum*. 26. Portion of a leafy stem, lateral view, × 10. 27. Portion of a cross-section of a stem, × 180. 28-29. Leaf (*A*), × 10; underleaf (*B*), × 10, and cells from the median portion of the leaf (*C*), × 180. Figures 26-28 were drawn from a portion of the original material of *Isotachis georgiensis* St., collected by Skottsberg in South Georgia (G); figure 29 was drawn from a portion of the original collection of *Mastigophora antarctica* St., collected by Skottsberg in South Georgia (G).

overlap. This is not the case in the leaves of *Triandrophyllum* which are bifid to trifid, for the sinus is distinctly triangular resulting in divergent segments.

Müller (1954) segregated the genus *Herberta* from the family Ptilidiaceae and proposed for it a new family, the Herbertaceae. He stated at that time that the genus *Herpocladium* probably belonged to this new family. Considering the close affinities between *Herberta* and *Herpocladium gracile*, his suggestion would seem to be valid.

Relationships among the three genera, *Herberta*, *Herpocladium* and *Triandrophyllum* are to be found in growth form, branching habit (almost exclusively ventral and intercalary), shape of leaves and underleaves (nearly equal in size), and structure and development of male and female inflorescences. The male branches of all three genera are nearly or quite radially symmetric, with antheridia borne in the axils of both bracts and bracteoles. The female inflorescence is terminal on the main stem. The bracts and bracteoles are in 2-3 series in a graded sequence from the leaves to the innermost and largest series. The perianth is oblong, divided in the upper part into 6-9 lanceolate segments. The calyptra is of the type to which Knapp (1930) has applied the term "shoot calyptra" since stem tissue in addition to the venter of the fertilized archegonium is involved in the formation of the structure and sterile archegonia are carried up onto its surface. The major difference among these three genera is in the cellular structure of their leaves and stems. Because of these close relationships, *Triandrophyllum* should be included in the family Herbertaceae.

Unfortunately, Müller did not include a Latin diagnosis with the description of his family Herbertaceae. The following diagnosis, therefore, qualifies the name Herbertaceae as a valid epithet and includes certain necessary emendations.

Herbertaceae K. Müller *emend.* Fulford & Hatcher. Plantae saepe robustae et rigidae, ramis ventralibus ex axillis amphigastriorum, rarius lateralibus. Folia incuba, asymmetrica vel subsymmetrica, bi- vel trifida, laciniis lanceolatis. Amphigastria symmetrica, foliis similima. Dioica. Androecia terminalia vel subterminalia, antheridia in axillis foliorum et in axilla amphigastrii androeciorum. Folia et amphigastria floralia caulinis similia sed majora, perianthia terminalia, oblongo-fusiformia, 3-6 plicata, apice 6-9 fissa.

It has been necessary to emend Müller's original description of this family in so far as he misinterpreted the character of the branches as originating in the axils of lateral leaves. Evans (1917,

p. 195) said that branching in *Herberta* is always intercalary and that normal vegetative branches take their origin in the axils of underleaves. Müller stated also that all the leaf cells possess strong, knot-like wall thickenings. While this is the case in *Herberta* and *Herpocladium*, the cell walls of *Triandrophyllum* are uniform and rather thin, with inconspicuous trigones.

LITERATURE CITED

EVANS, A. W. 1917. Notes on the genus *Herberta*, with a revision of the species known from Europe, Canada and the United States. Bull. Torrey Bot. Club 44: 191-222.

KNAPP, E. 1930. Untersuchungen über die Hüllorgane um Archegonien und Sporogonien der akrogynen Jungermaniaceen. Bot. Abhandl. 16: i-iv, 1-168.

MÜLLER, K. 1954. Die Lebermoose Europas. *In* Rabenhorst's Kryptogamen-Flora VI. Aufl. 3. Lief. 4, pp. 481-640. Leipzig.

THE MOSSES OF NORTH CAROLINA. VIII. GRIMMIACEAE TO ORTHOTRICHACEAE[1]

LEWIS E. ANDERSON[2]

GRIMMIACEAE

GRIMMIA APOCARPA Hedw. On rocks, both calcareous and noncalcareous, in numerous situations regarding light, shade and water. NO. MTS.: Ashe Co., *L. E. A.* 7679; Avery Co., *L. E. A.* 4021, *Anderson* & *Jones* 9546; Burke Co., *Anderson* & *Jones* 9344; Madison Co., *L. E. A.* 2936, 2947; Mitchell Co., *Anderson* & *Jones* 9419, 9420; Wilkes Co., *L. E. A.* 7495; Yancey Co., *L. E. A.* 7410, 10910, 12787, *Anderson* & *Jones* 9740. SO. MTS.: Buncombe Co., *L. E. A.* 6574; Jackson Co., *L. E. A.* 10096, 10716; Macon Co., *L. E. A.* 8903, 11247; McDowell Co., *L. E. A.* 3040, 7446, *Anderson* & *Jones* 9693, 9713; Swain Co., *L. E. A.* 2879. NO. PIEDMONT: Forsyth Co., *Schallert* '21; Orange Co., *Blomquist* 2761; Randolph Co., *L. E. A.* 2337, Yadkin Co., *L. E. A.* 6545.

[1] Part II., Introduction, appeared in THE BRYOLOGIST 41: 1-11. 1938; Part III, Andreaeaceae to Fissidentaceae, 41: 82-90; Part IV, 41: 118-123; Part V, Dicranaceae to Calymperaceae, 42: 62-70; Part VI, Encalyptaceae to Pottiaceae, 54: 145-161; Part VII, Addenda and Corrections, 61: 204-213. This study was aided by grants over a period of years from the Research Council of Duke University and by a grant from The National Science Foundation to Duke University (NSF G-23-222). I am also indebted to the Highlands Biological Station for support for field work from the Margaret Cannon Howell Fund.

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So. Piedmont: Lincoln Co., *L. E. A.* 7823; Stanly Co., *L. E. A.* 6298. So. Coast.: New Hanover Co., *L. E. A.* 6852. After studying the rather large series of specimens of this highly variable species, I have concluded that it is unwise to attempt varietal segregation. With the exception of var. *stricta* (Turn.) Mitt. (and its nomenclatural status is complicated almost beyond belief), I am unable to match the North Carolina variations of this complex with the described epithets as they are currently understood. There is the most puzzling intergrading and overlapping of forms, and even if certain of them could be assigned to varietal names, there would still remain a curious assemblage of variants to be lumped with *G. apocarpa* proper. A disturbing criticism of moss taxonomy concerns the all-too-common practice of separating a few more or less well-marked "varieties" or sub-epithets from an exceedingly polymorphous species, leaving the specific epithet to include a heterogeneous spectrum of unassigned forms. Perhaps Nyholm (Illus. Moss Fl. of Fennoscandia, fasc. 2, p. 145. 1956) is correct in stating that it will be necessary to carry out culture experiments before this species can be understood.

The so-called var. *stricta*, in its best development, is a very distinctive and attractive moss. It seems to reach maximum development at high altitudes, 6000 ft. and above, where it forms large loose tufts, reddish or reddish-brown in color, and with long robust stems, so that the whole aspect of the mat reminds one of a species of *Rhacomitrium*. The leaves of var. *stricta* are usually somewhat secund, longly acuminate, and conspicuously papillose-mammillose on the back. On Bluff Overlook, adjoining the Blue Ridge Parkway, Wilkes Co. (*L. E. A.* 7530), I collected a specimen in which the papillae project to a height of 5 μ or more. I have cited below only those specimens that typify the variety, but they furnish ample evidence of its commonness in the Mountains of North Carolina.

Grimmia apocarpa Hedw. var. stricta (Turn.) Mitt. (*G. gracilis* Schleich.) Habitat similar to the species; more abundant at higher elevations in shaded somewhat moist places. No. Mts.: Ashe Co., *L. E. A.* 5882; Wilkes Co., *L. E. A.* 5907, 7500, 7530. So. Mts.: Buncombe Co., *L. E. A.* 6573; Clay Co., *L. E. A.* 8005, 8055; Graham Co., *L. E. A.* 1587; Haywood Co., *McAllister* 193, *L. E. A.* 255; Jackson Co., *L. E. A.* 657, 9959, 10004, 10178; Macon Co., *L. E. A.* 7951, 8337; Swain Co., *L. E. A.* 477.

Grimmia cribosa Hedw. Known from a single collection. No. Mts.: Alleghany Co., exposed granitic rocks, south exposure, Bluff Mt., Blue Ridge Parkway, alt. 5000 ft., *L. E. A.* 7633, July

14, 1948. Mr. E. B. Bartram suggested the determination for this specimen, and it was confirmed by Dr. Geneva Sayre. A. J. Sharp has also collected *G. cribosa* in Tennessee, the identification of which was also made by Dr. Sayre. This species represents a remarkable addition to the moss flora of the Southern Appalachians and follows a familiar disjunct distributional pattern. Previously, *G. cribosa* was known only from mountainous regions in western North America, from British Columbia, Idaho and Arizona (Jones, *in* Grout, M. F. N. A. 2: 20. 1933). It occurs in Greenland, across northern Europe and in Asia.

Although not fruiting, the North Carolina and Tennessee collections are both unmistakably *G. cribosa*. Plants in the Tennessee collection are better developed, occurring in dense short cushions, with longer stems and broader and longer leaves with longer hair points. The North Carolina plants are darker in color and shorter with less well-developed leaves and hair points; but both exhibit the characteristic prominent plicae on each side of the costa and the rectangular, pellucid basal cells, rather thin-walled, non-sinuose and conspicuously elongated near the costa. (I am indebted to Harold Robinson for furnishing these comparative data on the North Carolina and Tennessee specimens.)

The North Carolina plants grew on bare granitic surfaces on the south side of a huge rock exposure, which is adjacent to the divide and is on the Escarpment of the Blue Ridge Mountains. There were no other species in association, although nearby in similar situations were *Polytrichum piliferum* Hedw., *P. juniperinum* Hedw., *Grimmia olneyi* Sull., *Campylopus flexuosus* Brid. and *Grimmia laevigata* (Brid.) Brid.

GRIMMIA DONIANA Sm. This species is also known from a single locality in the extreme northwest portion of the state. No. MTS.: Ashe Co., bare granitic rock exposure, Perkins Rock, Bluff Mt., southeast of Creston, *L. E. Anderson & E. F. Jones* 9634, August 27, 1950, *c. fr.* Grout (M. F. N. A. 2: 286. 1940) reported *G. doniana* from North Carolina, crediting the specimen to me, but this report was an error for the specimen cited above is the only one that I have collected, and it was obtained a full ten years after Grout's report. Apparently this species has not been collected previously south of Vermont. Like the previous species it is also more abundant in western North America, where it is known from Alberta to New Mexico.

GRIMMIA LAEVIGATA (Brid.) Brid. On exposed granitic or siliceous rocks, predominantly on extensive rock exposures, rarely on boulders or in shaded places. No. MTS.: Alleghany Co., *L. E.*

A. 8214, 8218; Ashe Co., *Correll* 10852; Caldwell Co., *Small* & *Heller* '91; Wilkes Co., *L. E. A.* 5912. So. Mts.: Graham Co., *L. E. A.* 8178; Haywood Co., *L. E. A.* 337; Jackson Co., *L. E. A.* 3244, 9946; Transylvania Co., *L. E. A.* 8401. No. Piedmont: Alexander Co., *Keever* 531, 549, 546; Durham Co., *Blomquist* 2159, 2161; Forsyth Co., *Schallert* '20; Franklin Co., *E. Beaven* 587; Orange Co., *L. E. A.* 1092; *Blomquist* 7046; Randolph Co., *L. E. A.* 7311; Surry Co., *L. E. A.* 7793; Wake Co., *Blomquist* 2158. So. Piedmont: Rowan Co., *Small* 9129; Rutherford Co., *Keever* & *Quarterman* '52; Stanly Co., *Small* '02 (as *G. glauca* Card.). This species represents the common and abundant *Grimmia* of the extensive granitic rock exposures in the Mountains, Upper Piedmont, and along the Fall Line. It plays an important pioneer rôle in initiating plant succession on such exposures and, current textbooks notwithstanding, it does not have to be preceded by crustose lichens or other vegetation. Plants of *G. laevigata* are able to gain a foothold directly on unoccupied granite (see Catherine Keever, Ecology 38: 422-429. 1957), subsequently developing extensive circular tufts, often several feet in diameter. These tufts trap soil and vegetable matter that provide an environment in which foliose lichens and later, higher plants, can become established. Eventually a mat of vegetation develops with *G. laevigata* occupying the peripheral and pioneer position, spreading centripetally as the mat increases in diameter.

Along Little Long Creek, Albemarle, Stanly Co., John K. Small collected a specimen in 1892 that was identified and subsequently reported in the literature as *G. glauca* Card. The plants resemble *G. laevigata* very closely and appear to be nothing more than an extreme xeric form of that species. This opinion was originally expressed by Sayre (*in litt.*) and I am in complete agreement. Thus *G. glauca* should be excluded from the moss flora of North Carolina.

Grimmia olneyi Sull. On granitic and calcareous rocks, exposures, boulders and cliffs. No. Mts.: Alleghany Co., *L. E. A.* 9751; Burke Co., *L. E. A.* 4071. So. Mts.: Jackson Co., *L. E. A.* 9947; Macon Co., *L. E. A.* 10439. No. Piedmont: Alexander Co., *Keever* 596; Forsyth Co., *Schallert* '23, '25; Stokes Co., *Schallert* '27. So. Piedmont: Montgomery Co., *L. E. A.* 6305. Previously considered rare in North Carolina, this moss is frequent and widely distributed in the Mountains and Upper Piedmont. It is essentially montane, occurring predominantly at altitudes above 4000 ft., and the Piedmont stations are mostly on elevated outliers. The Montgomery Co. station is, however, no

more than 800 ft. in altitude, but the substrate there is calcareous. Jones (M. F. N. A. 2: 40. 1933) states that *G. olneyi* is restricted to non-calcareous rocks, but that is not the case in North Carolina, where, of the nine collections cited, five came from limestone or calcareous rocks.

With sterile material it is not always easy to distinguish *Grimmia olneyi* from *G. pilifera*—a point that will be discussed under the latter.

GRIMMIA PILIFERA P. Beauv. (*G. pensilvanica* Schwaegr.) Common on all types of rocks in many types of situations from wet to dry, exposed to shaded. No. MTS.: Alleghany Co., *L. E. A.* 5814, 7636, 8196; Ashe Co., *L. E. A.* 7671, 7677; Avery Co., *L. E. A.* 7453, 7454; Burke Co., *L. E. A.* 4405, *Anderson & Jones* 9272; Madison Co., *L. E. A.* 3378; Watauga Co., *Small & Heller* 191, *Blomquist* 2166; Wilkes Co., *L. E. A.* 7479; Yancey Co., *L. E. A.* 3433. So. MTS.: Cherokee Co., *L. E. A.* 8091, 8098; Graham Co., *L. E. A.* 8136, 8189; Haywood Co., *L. E. A.* 260; Jackson Co., *L. E. A.* 144, 1369, 3252, 4250, *Blomquist* 2160, 9920; Macon Co., *L. E. A.* 1345, 8335; McDowell Co., *L. E. A.* 7349, *Anderson & Jones* 9694; Polk Co., *Correll* 4474; Swain Co., *Welch* 2864, *L. E. A.* 3877; Transylvania Co., *L. E. A.* 8308, 12826, *Grout* '07. No. PIEDMONT: Alexander Co., *L. E. A.* 3452, 7570; Chatham Co., *L. E. A.* 2286; Davidson Co., *L. E. A.* 2404; Durham Co., *Blomquist* 2157, 2164; Forsyth Co., *Chapman* '20; Franklin Co., *Beaven* 229; Orange Co., *Blomquist* 7330; Person Co., *Blomquist* 11009; Randolph Co., *L. E. A.* 2318, 7303, 7322; Stokes Co., *Schallert* '21, '26; Surry Co., *R. Williams* 478, *Blomquist* 6644; Yadkin Co., *L. E. A.* 6539. So. PIEDMONT: Anson Co., *Chapman* '21; Catawba Co. *L. E. A.* 7235; Montgomery Co., *L. E. A.* 6311; Rowan Co., *Schallert* '36, *L. E. A.* 2465; Stanly Co., *Small* '96. This species is the commonest and most abundant *Grimmia* in the state, not even excluding *G. apocarpa* and its forms. An habitual associate of *Dicranum fulvum* Hook., *Hedwigia ciliata* Hedw., *Ptychomitrium incurvum* (Muhlenb.) Sull. and numerous lichens, *G. pilifera* is even found rarely on the bark of trees. It occurs unquestionably in every Piedmont and Mountain county and is rare or uncommon in the Coastal Plain for lack of rock substrates.

Oddly enough, in North Carolina *G. pilifera*, in sterile condition, can be confused with *G. olneyi* in spite of the fact that the two species belong to quite different sections of the genus and appear not to be very closely related, at least for *Grimmia*. Much confusion arises because most manuals and keys state erroneously

that the margins of the leaves of *G. pilifera* are strongly recurved in the lower half. At best the basal margins are only somewhat recurved and reflexed, and many plants are found that have leaves which are only slightly plicate near the margin and a few are found that are entirely plane. The margins may often appear to be strongly recurved, but this appearance is caused by the thick bistratose margin which extends well into the basal portion of the leaf. The leaves of *G. pilifera* are strongly keeled and the costa projects prominently on the dorsal surface, a feature that can be observed even with very low magnifications. In contrast, the leaves of *G. olneyi* are scarcely keeled but are essentially U-shaped in cross section, and the costa of the latter does not project prominently on the dorsal surface. More striking are differences in the basal leaf cells of the two species. In *G. pilifera* quadrate upper cells become gradually more rectangular and elongate toward the base, at the same time becoming more thick-walled and sinuose. At the extreme base and especially near the costa the cells are very long, thick-walled and yellowish in color. At the basal angles there is an area of alar cells from 3 to 8 cells wide; these cells are usually hyaline, quadrate to rectangular and extend up the margin about one-fourth the length of the leaf base. In *G. olneyi* the basal leaf cells are composed mostly of rather large quadate cells whose horizontal walls are appreciably thickened but have no tendency whatever toward being sinuose. There may be a few elongated cells near the costa, but they are never as prominent as in *G. pilifera*. The alar cells are less numerous in *G. olneyi*.

Several specimens of *G. pilifera* from North Carolina have quadrate basal cells that extend almost to the base of the leaf, where they become rectangular and yellowish. Correlated with this are usually straight walls. If, in addition, the costa is semiflattened, there is considerable resemblance to *G. olneyi*. The basal cells of the latter, however, are very much larger; these cells, together with the less prominent and more obscure costa and the U-shaped concavity of the leaves, serve to distinguish these somewhat puzzling forms.

Occasional specimens of *G. pilifera* are found that are unusually robust, some with leaves up to 4 or 5 mm. long and even longer. In one collection (*Blomquist* 2157, Orange Co.) the upper leaves (not the perichaetial) have long hair points occupying at least half the total length of the leaf, and furthermore the hair points are somewhat flattened at the base and decurrent, as in *G. laevigata*. A specimen from Montgomery Co. (*L. E. A.* 6311) is

noteworthy because all of the cells making up the leaf bases (except the costa) are colorless or hyaline.

HEDWIGIA CILIATA (Hedw.) P. Beauv. (*H. albicans* Lindb.) On calcareous and non-calcareous rocks in all types of situations; occasionally on soil and rarely on the bark of hardwoods. No. MTS.: Alleghany Co., *L. E. A.* 7651, 7774, 8215; Ashe Co., *L. E. A.* 5829, 7724; Avery Co., *L. E. A.* 7458, *Anderson* & *Jones* 9541; Burke Co., *L. E. A.* 4074, 4404; Madison Co., *L. E. A.* 3380; Mitchell Co., *Anderson* & *Jones* 9412; Yancey Co., *L. E. A.* 3430. So. MTS.: Buncombe Co., *L. E. A.* 842a, 4201; Cherokee Co., *L. E. A.* 8092; Clay Co., *L. E. A.* 8067, 10649, *W. L. Culberson* 5594; Graham Co., *L. E. A.* 8188; Haywood Co., *L. E. A.* 284, 523, 584, *McAllister* 104; Jackson Co., *L. E. A.* 66, 617, 8695, 10720; Macon Co., *L. E. A.* 4167, 7875, 11215; Swain Co., *L. E. A.* 216, 3312; Transylvania Co., *Grout* '07. NO. PIEDMONT: Alexander Co., *Keever* 584, *L. E. A.* 3462; Chatham Co., *L. E. A.* 2253; Davidson Co., *L. E. A.* 1028, 2403; Durham Co., *Blomquist* 2170; Forsyth Co., *Schallert* '20; Franklin Co., *Beaven* 301; Orange Co., *Blomquist* 2760; Person Co., *Blomquist* 11008; Surry Co., *Correll* & *McDowell* 10743, *R. Williams* 539. So. PIEDMONT: Anson Co., *L. E. A.* 4929; Cabarrus Co., *L. E. A.* 1016; Catawba Co., *L. E. A.* 3482; Mecklenburg Co., *L. E. A.* 2513; Montgomery Co., *L. E. A.* 4863; Rowan Co., *L. E. A.* 2466, 9182; Rutherford Co., *L. E. A.* 2650; Stanly Co., *Small* '92; Union Co., *L. E. A.* 4897.

This genus most certainly does not belong in the Grimmiaceae, but I am including it here simply to be consistent with the order in Grout's *Moss Flora of North America*, which this series of articles has been following.

I am not impressed with the attempts that have been made to apply epithets to the several variations of *H. ciliata*. In our material the degree of ciliation, *e.g.*, of the perichaetial leaves, varies enormously with the same colony or clump, and the development of the hyaline point on stem leaves is quite variable even on the same plant.

CAMPYLOSTELIUM SAXICOLA (Web. & Mohr) BSG. On non-calcareous rocks, restricted to moist shaded sites. So. MTS.: Jackson Co., *L. E. A.* 10212, 10228; Macon Co., *Sharp* 34671; Transylvania Co., *Grout* '07. Apparently this tiny moss is not known further south and is rare or else overlooked. Of the two collections that I have made, one came from granite, the other from gneiss. The distinctive arcuate seta, evident only when wet, identifies this species with ease. I suspect that it is much more

common than the collections indicate. Dried plants might be passed up in the field for the common *Ptychomitrium incurvum*.

PTYCHOMITRIUM INCURVUM (Muhlenb.) Sull. On calcareous and non-calcareous rocks in a variety of situations, but most frequently on boulders, rarely on tree trunks. NO. MTS.: Alleghany Co., *L. E. A.* 5816, Burke Co., *Anderson & Jones* 9307; Madison Co., *L. E. A.* 3403; Yancey Co., *L. E. A.* 3431. SO. MTS.: Cherokee Co., *L. E. A.* 8094; Graham Co., L. E. A. 8175; Haywood Co., *L. E. A.* 193, 271, 593; Jackson Co., *L. E. A.* 59, 358; Swain Co., *L. E. A.* 2875; Transylvania Co., *Grout* '07, *Bryan* 458. NO. PIEDMONT: Alexander Co., *L. E. A.* 3451; Chatham Co., *L. E. A.* 2254; Davidson Co., *L. E. A.* 2401; Durham Co., *Blomquist* 229, 2347, *L. E. A.* 1058; Forsyth Co., *Schallert* '20, '25, '33 (Verdoorn, *Musci Selecti et Critici II, No.* 87); Franklin Co., *Beaven* 587; Orange Co., *Blomquist* 1004; Person Co., *Blomquist* 11011; Stokes Co., *Schallert*, '24, '25, '26; Surry Co., *L. E. A.* 7800, *Ruby Williams* 227; Wake Co., *Blomquist* 2422. SO. PIEDMONT: Anson Co., *Schallert* '36; Montgomery Co., *L. E. A.* 4844; Rowan Co., *L. E. A.* 2454; Rutherford Co., *L. E. A.* 2647; Stanly Co., *L. E. A.* 6302; Union Co., *F. W. Gray* NCM282. This species occurs abundantly on limestone and other calcareous rocks as well as on sandstone, granite and gneiss. It sometimes occurs on tree trunks and may be confused with *P. drummondii*, which typically is corticolous, but on occasions also exchanges habitats with *P. incurvum* and occurs on rocks, especially on brick or stone walls in towns and cities. The two species are easily distinguished under the microscope, however. The leaves of *P. drummondii* are acute and have denticulate to serrate margins, whereas the apices of the leaves of *P. incurvum* are obtuse to cucullate with entire margins or very rarely with the faintest suggestions of denticulations.

PTYCHOMITRIUM DRUMMONDII Sull. On tree trunks, rarely on rocks. NO. PIEDMONT: Davidson Co., *L. E. A.* 7816; Durham Co., *Blomquist* 7648; Vance Co., *L. E. A.* 6118. SO. PIEDMONT: Anson Co., *L. E. A.* 5021; Cleveland Co., *L. E. A.* 7826; Lincoln Co., *L. E. A.* 7821; Mecklenburg Co., *L. E. A.* 6097; Union Co., *F. W. Gray* NCM281. NO. COAST.: Dare Co., *L. E. A.* 6520; Hertford Co., *L. E. A.* 5688; Hyde Co., *L. E. A.* 4663; SO. COAST.: Brunswick Co., *L. E. A.* 6825; Carteret Co., *L. E. A.* 6687; Columbus Co., *Blomquist* 10135; Cumberland Co., *L. E. A.* 6140; Duplin Co., *L. E. A.* 6785; Jones Co., *E. Sherwin* 825; Sampson Co., *L. E. A.* 3838. It is entirely possible that the native range

of this moss includes only the Coastal Plain, for all of the Piedmont specimens are from trees along city streets, where it is a constant associate of *Tortula pagorum* (Milde) DeNot., *Orthotrichum pusillum* Mitt., *Drummondia prorepens* (Hedw.) Jenn. and *Fabronia ciliaris* (Brid.) Brid. In the Coastal Plain, however, it is a characteristic plant of swamps, where it grows abundantly on the bark of cypress, swamp gum, white cedar, etc. and is not in any sense restricted to urban localities. It is unknown in the Mountains and is essentially a southern or sub-tropical species ranging northward in the Coastal Plain, possibly adventive only in the Piedmont.

RHACOMITRIUM ACICULARE Brid. On wet or moist rocks and boulders in streams or near waterfalls, usually in sunny places. NO. MTS.: Burke Co., *Anderson & Jones* 9331; Mitchell Co., *Anderson & Jones* 9420; Watauga Co., *Small & Heller* '91, *Blomquist* 2353. SO. MTS.: Clay Co., *L. E. A.* 8003; Jackson Co., *L. E. A.* 689, 6628, 7879, 8677, 10484, 10566; Macon Co., *L. E. A.* 882, 7984, 8585; Swain Co., *Blomquist* 2354; Transylvania Co., *L. E. A.* 8295, 9033. NO. PIEDMONT: Forsyth Co., *Schallert* '21; Stokes Co., *L. E. A.* 5757. This species is characteristic of boulders and rocks in or along streams. It is the most distinctive and least variable member of the family in North Carolina. The leaves are uniformly obtuse and dentate, and apparently entire-leaved forms do not occur in the Southern Appalachians. It is essentially montane. The two Piedmont stations are montane in habitat, and support other species that are typically montane.

RHACOMITRIUM HETEROSTICHUM (Hedw.) Brid., *sensu latissimo*: Including *R. sudeticum* (Funck) BSG. and possibly *R. microcarpum* (Hedw.) Brid. (*R. ramulosum* Lindb.). Rocks and boulders, exposed and shaded, xeric to moist situations. NO. MTS.: Alleghany Co., *L. E. A.* 8224, 8226; Avery Co., *L. E. A.* 4005; Buncombe Co., *L. E. A.* 6573a; Burke Co., *L. E. A.* 4075; Mitchell Co., *Schallert* M42, M51, M75, M181, *Blomquist* 2169, *E. B. Curtis* '02, *L. E. A.* 4133; Wilkes Co., *Schallert* '02, *L. E. A.* 7547; Yancey Co., *L. E. A.* 7413, 7414, 7421, 7422, 7423, 7430, 10923, 10933, 10950, 10972, 10990, 11010, 11003, 11012, 11015. SO. MTS.: Haywood Co., *L. E. A.* 11266, *G. F. Beaven* 371, 372, *A. L. Price* M337, *B. McAllister* 192; Jackson Co., *L. E. A.* 635a, 695, 10200, 10736, 10768, *Blomquist* 2165; Macon Co., *L. E. A.* 1352, 4181, 8615, 10042, 10386, 10393, 11046, 11212; Swain Co., *L. E. A.* 3259; Transylvania Co., *L. E. A.* 9013, 11162, 13025, 13026. NO. PIEDMONT: Alexander Co., *Keever* 461, 597, *L. E. A.*

7591, 7594; Stokes Co., *Schallert* '21. In spite of the wide choice of epithets available within this complex, I am unable to find satisfactory names for variations from North Carolina. Sayre has underway a comprehensive study of this genus in North America, and so rather than add to existing confusion I shall postpone any attempt to apply segregate names to our material, pending the outcome of her studies.

Variations within this complex in all parts of the world principally concern four characters. Subdivisions into segregate species, subspecies, varieties or forms have been based mainly upon different combinations of these four variable characters: (1) shape and length of the upper leaf cells, varying from short and quadrate to long-rectangular; (2) the presence or absence of short lateral branches, varying from none or few to many; (3) the number of layers of cells comprising the lamina in the upper part of the leaves, varying from completely unistratose to variously bistratose, from a single row of bistratose marginal cells to the whole upper lamina composed of two layers of cells; and (4) the development of the hair point, varying from none (muticous) to a long hyaline hair-point, flat and conspicuously decurrent at the base. In the Southern Appalachians a fifth variable is encountered, namely that of papillosity of leaf cells.

In North Carolina the most common variation in this complex is characterized by plants with relatively elongated upper cells, numerous short lateral branches, and fairly long hyaline points, broad and flat at the base and distinctly decurrent, and with smooth or nearly smooth leaf cells. These plants are found at moderate altitudes, usually in dense mats on exposed granitic outcrops. Jones, in his study of *Rhacomitrium* for the *Moss Flora of North America* (2: 50-60. 1933), referred these plants to *R. heterostichum* var. *ramulosum* (Lindb.) Jones, an epithet which he used to avoid confusion surrounding the prior name, *R. microcarpon* (Hedw.) Brid. A difficulty, though, is the fact that all of the Appalachian plants have distinctly bistratose leaf margins and unless this is a feature that can be admitted to *R. microcarpon*, then some other disposition will have to be made of the Appalachian material. In addition, I have found that a remarkable number of plants in this category have distinctly papillose leaf cells, varying from plants in which only a few cells at the extreme leaf tips have a few sparse low papillae to plants in which all of the cells in the upper half of the leaves are densely and conspicuously papillose with low rounded papillae. The hyaline points are not papillose, but are denticulate. I have examined more than a dozen specimens

from North Carolina with the following combination of characters: upper leaf cells elongate, distinctly papillose, margins bistratose, hyaline hair point moderately developed, usually decurrent at base, denticulate but not papillose, and stems usually with many short lateral branches. The best development of these papillose forms occurs on Mt. Mitchell, at altitudes 6000 feet and above, on boulders and exposed rocks in the spruce-fir zone (*L. E. A.* 7421, 7422, 7423, 7424). Several specimens have been collected in good fruiting condition. The capsules are short cylindrical to ellipsoidal, and the peristome characters agree with *R. heterostichum*.

A large number of collections contain plants in which the upper leaf cells tend to be short and isodiametric. Forms which combine with this character few or no short lateral branches, short hyaline points and bistratose leaf margins have been called *R. sudeticum* Funck or *R. heterostichum* var. *sudeticum* (Funck) Jones. The North Carolina specimens exhibit complete intergradation from relatively long-rectangular leaf cells characteristic of the aforementioned variants to short-rectangular isodiametric cells. There is also variation in the amount of the leaf occupied by the short cells. In some specimens the entire upper half of the leaves is composed of short cells but in other specimens the upper quadrate cells occupy much less than half the length of the leaf. The development of the characteristic short lateral branches is also a matter of degree. When short leaf cells are found in plants with numerous short lateral branches, distant leaves, and slender and more elongated stems, the var. *affine* (Schleich.) Corb. apparently is indicated, although I have not seen specimens from the Southern Appalachians that exactly match material from northern U. S. and Canada referred to this variety. The var. *gracilescens* BSG is also a slender form similar to var. *affine* but with few or no short lateral branches. I have seen only a single specimen from North Carolina that varies in this direction. An occasional specimen is muticous, or nearly so, and resembles the so-called fo. *obtusum* (Sm.) Mönkem. of var. *affine;* again, North Carolina plants are a poor match for European specimens that have been so identified.

I collected an unusual specimen (*L. E. A.* 4181) on vertical moist rocks at "The Narrows" of the Chattooga River, south of Highlands, in Macon Co., N. C., in which the leaves are blunt and obtuse, some nearly cucullate, almost without hair points, with no short lateral branches and with long robust stems. The upper leaf cells are short-rectangular to quadrate. The plants bear a superficial resemblance to the var. *macounii* (Kindb.) Jones, but the leaves, when dry, are not twisted or curled and, when wet, are

not recurved as are the Macoun specimens upon which the variety was based.

P. O. Schallert distributed specimens from Stokes Co., N. C., labelled *R. fasciculare* (Hedw.) Brid., but I am confident they were all misdetermined. The ones I have examined are papillose forms of the *R. heterostichum* complex, with short hair points, quadrate upper cells and bistratose margins. There are no specimens of *R. fasciculare* in the Duke Herbarium collected south of New York, and I believe the species can be safely excluded from North Carolina.

Ephemeraceae

Ephemerum crassinervium (Schwaegr.) Hampe. (*E. papillosum* Aust.; *E. crassinervium* var. *papillosum* Ren. & Card.) Bare soil, recently disturbed areas, among sparse vegetation, old fields, along river banks, mud flats, or recently inundated soil. So. Mts.: McDowell Co., *Bryan* 450. No. Piedmont: Durham Co., *Anderson & Bryan* Cyt.-202, Cyt-203, Cyt.-204, Cyt.-250, *R. B. Channell* 250, *L. E. A.* Cyt.-435, Cyt.-442; Orange Co., *Blomquist* 8360, *J. N. Couch* '35. So. Piedmont: Mecklenburg Co., *F. W. Gray* M1345, M1347, M1349.

Ephemerum crassinervium var. texanum (Grout) Bryan & Anderson. (*E. spinulosum* var. *texanum* Grout.) Bare soil, revegetating paths, old fields, ditch banks, edge of ponds, etc. No. Piedmont: Durham Co., *Bryan* 441, *L. E. A.* 12580, 12586; Orange Co., *Anderson & Bryan* 12660. So. Piedmont: Mecklenburg Co., *F. W. Gray* M1359. So. Coast.: New Hanover Co., *Schuster & Bryan* 320A. This is a very distinctive variety in North Carolina and, like other Ephemeraceae, is doubtless much more common than collections indicate. The leaves are broader in the variety than in the species, and the upper leaves tend to have broad shoulders deeply incised or spiny-toothed. The leaf cells are densely papillose in all of the specimens from our area.

Ephemerum cohaerens (Hedw.) Hampe. On bare soil, especially, apparently, on plowed ground packed by rains. No. Piedmont: Durham Co., *Anderson & Bryan* 473, Cyt.-473, *L. E. A.* 12666, *Anderson & Bryan* Cyt.-494. This species is not common in the vicinity of Durham, where Virginia Bryan and I have searched for ephemeraceous mosses for a number of seasons. We have collected it in three places. The most abundant locality was a gently sloping field on the edge of a flood plain, the lower portion of which was subject to inundation. The field was plowed and planted in oats in late September 1955. On November 13 we

collected scattered plants of *Ephemerum cohaerens* mixed with a quantity of *E. spinulosum*, some *E. crassinervium*, *Physcomitrium pyriforme*, *Funaria hygrometrica*, *F. flavicans*, *Weissia controversa* and several species of the hepatic, *Riccia*. We made additional collections of *E. cohaerens* at the same locality on December 12 and on January 5, but by mid-February there were no plants to be found. During the winter of 1955-1956 we observed at intervals another colony of *E. cohaerens* from the time of its discovery on December 5 until the plants disappeared in late February. This colony occurred in a pasture on bare soil from which grass sod had been removed the previous year. The slight depression left after removal of the sod accumulated water following rains and apparently provided an ideal habitat for *Ephemerum*. In the same spot we also collected *E. crassinervium* var. *texanum* and *E. spinulosum*.

EPHEMERUM SPINULOSUM Schimp. [*E. spinulosum* var. *hystrix* (Lindb.) Grout.] On bare soil in a variety of situations, especially pond margins, river banks, cultivated fields, bare areas among vegetation in swamps, occasionally on decayed wood in wet places. No. PIEDMONT: Durham Co., *Blomquist* 2123, 8750, *Bryan* & *Anderson* Cyt.-608, Cyt.-609, *Blomquist* & *Bryan* 181. So. PIEDMONT: Mecklenburg Co., *F. W. Gray* M1349. So. COAST.: Columbus Co., *Blomquist* & *Bryan* Cyt.-182, Cyt.-187, Cyt.-188. This species is the most abundant and most frequent *Ephemerum* in the vicinity of Durham. During the winter months it can be found in quantity in fields that were cultivated during the previous summer, especially in bottomlands. It is also a variable species, particularly as to degree of serration of the leaves, with variation from almost entire-leaved forms to those with numerous long and conspicuous spines. Also there are puzzling variations in the prominence of the costa in various specimens. Some have leaves with the costa prominent throughout and excurrent into a long spinulose awn, the spines projecting at right angles on all sides of the leaf. In North Carolina this is the most common form of the species and can be recognized in the field by the prominence of the spines. Plants with the costa lacking or indistinct at the base of the leaf have sometimes been referred to the var. *hystrix*, but Bryan and Anderson (THE BRYOLOGIST 60: 67-102. 1957) concluded that the variation was not worthy of taxonomic rank.

Grout (M. F. N. A. 2: 67. 1935) listed *Ephemerum serratum* (Hedw.) Hampe, from North Carolina, but the specimens upon which the report is based are depauperate and weakly costate forms of *E. spinulosum* (*F. W. Gray* M1349, *Blomquist* 8750).

Bryan and Anderson (*l. c.*) have pointed out that *E. serratum* is a more northern species and it apparently does not extend into the southeastern U. S.

NANOMITRIUM AUSTINII (Sull.) Lindb. Bare soil, mud flats, lake margins, among vegetation in bottomlands and swamps. No. PIEDMONT: Durham Co., *Anderson & Bryan* Cyt.-191, Cyt.-608, *L. E. A.* 12582; Forsyth Co., *Schallert* '20; Wake Co., *R. L. Wilbur* 3460. So. COAST.: Columbus Co., *Blomquist & Bryan* Cyt.-189, Cyt.-190.

NANOMITRIUM MEGALOSPORUM (Aust.) Lindb. [*Ephemerum megalosporum* (Aust.) Salm.] Bare soil, similar to the latter. No. PIEDMONT: Durham Co., *Bryan* Cyt.-607, *L. E. A.* 12584, *Bryan & Anderson* Cyt.-608, Cyt.-609. So. PIEDMONT: Mecklenburg Co., *F. W. Gray* M1640. So. COAST.: Bladen Co., *Blomquist* 11452; Columbus Co., *Schuster & Blomquist* 29429, *Blomquist & Bryan* Cyt.-187. All of the members of the Ephemeraceae produce capsules normally during late fall (late October or early November), the winter months and early spring (late March). Schuster and Blomquist, however, found a remarkable development of fruiting plants of *N. megalosporum* in a gum (*Nyssa aquatica*) swamp, 1.5 miles east of Whiteville, Columbus Co., on August 15, 1953 (No. 29429). On this date they found many plants with capsules containing mature spores and older plants in which the spores had obviously been shed for some time. This was an unseasonably wet summer, and a few weeks prior to this time the area had been covered with water. The area was revisited in September by Virginia Bryan, but there was no sign of plants of *N. megalosporum*. By October 23, however, the colony had reestablished itself and numerous plants were found with young capsules. Abundant material was collected by Blomquist and Bryan (Cyt.-187) in meiotic condition, so that Bryan was able to make chromosome counts (Bryan, THE BRYOLOGIST 60: 103-126) from this material.

NANOMITRIUM SYNOICUM (James) Lindb. No. PIEDMONT: Durham Co., on damp soil, recently inundated lake margin, partially shaded, Lake Michie, north of Durham, alt. 400 ft., *L.E.A.* 12588, November 21, 1954. Apparently this species is quite rare in North Carolina, at least in comparison with other members of the Ephemeraceae, as only one collection is known from the state. This collection was made near the end of one of the driest periods on record, at which time the lake margin of a large reservoir had receded for a distance of nearly one-fourth mile, leaving exposed a large mud or silt flat. In somewhat shaded portions of these large

flats there were enormous developments of not only *N. synoicum*, but also *N. austinii*, *N. megalosporum*, *Ephemerum crassinervium*, *E. spinulosum* and *Aphanorhegma serratum*. Over most of the area these species grew in relatively pure patches, but the three species of *Nanomitrium* were observed growing intermixed. These three species are easily distinguished, however, on the basis of capsule color. The capsules of *N. megalosporum* are orange to orange-brown, but in *N. austinii* they are dark brown to black, and bright red in *N. synoicum*. In addition, the long stems and recurved leaves of the latter contrast vividly with the almost stemless plants and erect leaves of *N. austinii*.

FUNARIACEAE

APHANORHEGMA SERRATUM (Hook. & Wils.) Sull. On bare soil, often clayey, open places among vegetation in bottomlands, in old fields, revegetating paths, moist freshly disturbed soil. No. PIEDMONT: Durham Co., *Bryan & Anderson* 12592, Cyt.-192, Cyt.-193, Cyt.-194, Cyt.-205, Cyt.-206.

PHYSCOMITRELLA PATENS (Hedw.) BSG. Moist clay banks and on pots in greenhouses. No. PIEDMONT: Durham Co., *Blomquist '29*, 2124, 2131. In October, 1929, H. L. Blomquist made three collections of this species, and it has not been collected since. One collection was obtained from greenhouse pots, but the other two collections came from moist clay banks near Durham. Both he and I have revisited this latter site numerous times in an effort to relocate colonies of this species but have been unable to find any plants. In the fall and winter of 1953-1954, Virginia Bryan and I visited the Blomquist locality at fairly regular intervals but could find no trace of *P. patens*.

PHYSCOMITRIUM PYRIFORME (Hedw.) Brid. [*P. turbinatum* (Mx.) Brid.] On previously cultivated soil, abandoned fields, roadsides, pastures, especially lowlands, ditch banks, etc. So. MTS.: Buncombe Co., *L. E. A.* 9879. No. PIEDMONT: Durham Co., *Correll* 8694, *Blomquist '30*, *Bryan* Cyt.-382; Surry Co., *Correll & McDowell* 10772; Franklin Co., *E. Beaven;* Granville Co., *L. E. A.* 2210; Vance Co., *L. E. A.* 2152; Wake Co., *L. E. A.* 3605. So. PIEDMONT: Gaston Co., *L. E. A.* 2565; Mecklenburg Co., *F. W. Gray* M1367; Rowan Co., *M. Merwin* 22. No. COAST.: Chowan Co., *L. E. A.* 6491; Johnston Co., *L. E. A.* 6225; Pitt Co., *M. Caughey '39*. So. COAST.: Carteret Co., *Blomquist* 8728; New Hanover Co., *L. E. A.* 6841. It is surprising that a moss as ubiquitous as *P. pyriforme* in North Carolina has been collected so little. I think it is safe to say that it occurs in abundance in

every county in the state, from sea level to the highest point 6684 ft., on Mt. Mitchell.

North Carolina is within the range of *Physcomitrium immersum* Sull., but to my knowledge it has not been collected in the state. It is reported from South Carolina (Grout, M. F. N. A. 2: 78. 1935) but apparently is not known from Tennessee or Virginia.

ENTOSTHODON DRUMMONDII Sull. Sandy and clayey soils in open woods. NO. PIEDMONT: Randolph Co., *L. E. A.* 7320. NO. COAST.: Tyrrell Co., *L. E. A.* 6527. SO. COAST.: Harnett Co., *Anderson & Evans* 6154, *Bryan* Cyt.-363; Moore Co., *Blomquist* 7649; Pender Co., *Anderson & Evans* 6169. North Carolina is apparently the northern limit of the known range of this moss, which is more common farther south in the Atlantic Coastal Plain and along the Gulf of Mexico. It is not a common moss in North Carolina, being infrequent and occurring rather sparsely. In the Coastal Plain it appears to be a species of the Sand Hills. I was, therefore, much surprised to find it at the top of Mt. Shephard, alt. ca. 1100 ft., a Piedmont monadnock-type of low mountain that is not at all Coastal in its floristic aspect. The crest of the mountain is occupied by an oak-hickory forest, the principal oak being chestnut oak (*Quercus prinus* L.).

FUNARIA FLAVICANS Mx. Clayey or sandy soil, road banks, wet meadows, burned-over areas, waste places, clear areas in woods, swampy situations, etc. NO. PIEDMONT: Alexander Co., *Keever* 441; Durham Co., *Blomquist* 2147, *Correll* 8693, *E. F. Jones* '41; Forsyth Co., *Schallert* '20, '21; Rowan Co., *M. Merwin* '35. NO. COAST.: Pitt Co., *M. Caughey* '39. SO. COAST.: Pender Co., *Anderson & Evans* 6173. This distinctive species is not common in the Piedmont and Coastal Plain and apparently is rare or nonexistent in the Mountains. It is easily distinguished from the common and weedy *F. hygrometrica* in the field by its very different capsule shape. The capsules of *F. flavicans* are globose-pyriform when moist, but are nearly cylindrical when dry in sharp contrast to the tapering and strongly unsymmetric capsule of *F. hygrometrica*. In addition, the capsules of the latter are strongly sulcate when dry, whereas in *F. flavicans* the dried capsules are irregularly wrinkled. Nearly all manuals refer to spore size differences between these two species, but this distinction does not always hold true. Two of the specimens of *F. flavicans* from North Carolina have spores as small as 16 μ, which is well within the normal range of spore size in *F. hygrometrica*.

FUNARIA HYGROMETRICA Hedw. In situtations similar to the latter, although much more common and weedy. NO. MTS.: Avery

Co., *Anderson & Jones* 9359; Madison Co., *L. E. A.* 718; Wilkes Co., *L. E. A.* 5917; Yancey Co., *L. E. A.* 10978, 11007. So. Mts.: Cherokee Co., *L. E. A.* 10703; Haywood Co., *G. F. Beaven* 391, *F. M. Watson* '28; Henderson Co., *Blomquist et al.* 7835; Jackson Co., *L. E. A.* 8374; Macon Co., *Correll & Correll* 7952; Swain Co., *L. E. A.* 2903; Transylvania Co., *Correll* 4424, 4431. No. Piedmont: Alexander Co., *Keever* 441 *p.p.*; Durham Co., *Blomquist* 2150, 2744; Forsyth Co., *Schallert* '20, '21; Franklin Co., *E. S. Beaven* 439; Orange Co., *Blomquist* 6123, *Correll* 4489; Surry Co., *Correll & McDowell* 10745. So. Piedmont: Randolph Co., *L. E. A.* 7305; Rowan Co., *M. Merwin* 35; Stanly Co., *L. E. A.* 9172. No. Coast.: Beaufort Co., *L. E. A.* 4628; Currituck Co., *L. E. A.* 39; Nash Co., *L. E. A.* 3661, 3664; Pitt Co., *M. Caughey* '39. So. Coast.: Bladen Co., *Blomquist* 7360; Brunswick Co., *L. E. A.* 3967, 6828, *Anderson & Evans* 6179; Carteret Co., *Blomquist* 8726, *Blomquist & Jones* 10217, *L. E. A.* 6683; Craven Co., *L. E. A.* 6661, *Correll* '35; Harnett Co., *Blomquist* 3114; Richmond Co., *Correll* '35; Robeson Co., *Correll* '35; Sampson Co., *L. E. A.* 3818, *Blomquist* 3127.

Funaria serrata Brid. Soil, banks, edge of swamps, sandy peaty soil, pastures etc. No. Piedmont: Durham Co., *Blomquist* 2149, 10239; Forsyth Co., *Schallert* '25; Orange Co., *Blomquist* 2743; Randolph Co., *L. E. A.* 7314, 9229. So. Piedmont: Gaston Co., *L. E. A.* 2564. No. Coast.: Hertford Co., *L. E. A.* 5700, 5701, 5701A; Johnston Co., *L. E. A.* 3613; Nash Co., *L. E. A.* 3642. I have found this species in abundance only once, on sandy, peaty soils along the edge of a large gum swamp near Murfreesboro, in Hertford Co. It is a southern species, apparently, ranging from North Carolina to Texas. Upon drying, the capsules of *F. serrata* bent at right angles just above the rather long and tapered neck impart a characteristic appearance. Also the capsules are among the smallest in the genus. Grout (M. F. N. A. 2: 89. 1935) stresses the fact that in *F. serrata* the costa ends below the leaf apex, but in nearly all of the specimens from North Carolina the costa is percurrent.

Splachnaceae

Tetraplodon pennsylvanicus (Brid.) Sayre (*T. australis* Sull. & Lesq.) No. Mts.: Avery Co., on cow dung in *Sphagnum* bog, near Pineola, alt. 3000 ft., *A. J. Sharp & S. A. Cain,* May 6, 1934. So. Mts.: Macon Co., on dung at edge of *Sphagnum*-Cranberry-*Spirea* bog-swamp, along Shortoff Road, 4 mi. out of Highlands off Cashiers Road, alt. 3850 ft., *K. A. Wagner* 1737, June

8, 1949. These are the only collections of this species that I have seen from North Carolina. Sayre (M. F. N. A. 2: 100. 1935) states the range as "Cape Breton, Nova Scotia and along the Atlantic Coast from New Jersey to Florida." However, I have seen no specimens of *T. pennsylvanicus* from the Coastal Plain of North Carolina. It is obviously not a frequent moss and its curious restriction to dung contributes to its being overlooked by collectors. Sharp (Amer. Midl. Nat. 21: 267-354. 1939) cites this species as an example of the familiar distributional pattern in which there is limited disjunct occurrence in the Southern Appalachians of a species whose greatest frequency is in the Coastal Plain. *Syrrhopodon texanus* Sull. and *Schlotheimia rugifolia* (Hook.) Schwaegr. are other species with similar types of distribution.

ORTHOTRICHACEAE

ORTHOTRICHUM EXIGUUM Sull. Bark of trees. NO. PIEDMONT: Forsyth Co., on bark of pear tree, near dwelling, Kernersville, alt. 1000 ft., June 15, 1947, *L. E. A.* 6950. SO. PIEDMONT: Union Co., bark of tree, Marshville, *F. W. Gray*, March 4, 1931 (as *O. pusillum* Mitt.). Both collections of this rare moss contain admixtures of *Tortula pagorum* (Milde) DeNot. The Forsyth Co., collection is reported here for the first time. The collection by Gray was discovered by Crum and Anderson (Jour. Elisha Mitchell Sci. Soc. 72: 276-291. 1956), who have discussed the species in some detail.

ORTHOTRICHUM KEEVERAE Crum & Anderson. Bark of hardwoods. NO. PIEDMONT: Alexander Co., on bark of stunted *Quercus montana*, exposed granitic rock outcrop, alt. 1812 ft., Rocky Face Mt., Brushy Mts., near Hiddenite, *L. E. Anderson* & *C. Keever* 7575, June 21, 1948 (TYPE); bark of hardwood, *ibid.*, *L. E. A.* 7586. This distinctive moss is still known only from the type locality. Its long-cuspidate leaves and unique peristome clearly set it apart from all other *Orthotricha* in the eastern U. S. The segments of the endostome are well developed, as broad and long as the teeth of the exostome, and are directed inward in a cone-like manner. The peristome teeth are pale yellowish while the segments are dark brown, a combination that presents a very colorful appearance.

ORTHOTRICHUM OBTUSIFOLIUM Brid. Bark of hardwoods. NO. MTS.: Ashe Co., bark of sugar maple, village square, Warrenville, *L. E. A.* 7690, July 15, 1948. SO. PIEDMONT: McDowell Co., bark of sugar maple, along city street, alt. 1425 ft., near courthouse, Marion, *L. E. A.* 9154, Sept. 6, 1949. This is the first report

of this species from North Carolina, and it is not known farther south. Both collections are sterile, but, in each, the plants bear abundant propagula. The McDowell Co. collection, although from the Piedmont, was obtained at the base of the Blue Ridge Escarpment.

ORTHOTRICHUM OHIOENSE Sull. & Lesq. Bark of trees. No. MTS.: Alleghany Co., *L. E. A.* 7753; Burke Co., *L. E. A.* 9352; Madison Co., *L. E. A.* 2986, 3384; Wilkes Co., *L. E. A.* 5901. So. MTS.: Clay Co., *L. E. A.* 8072; Henderson Co., *L. E. A.* 2777; Jackson Co., *L. E. A.* 7891, 7893, 10168; Macon Co., *L. E. A.* 10431; McDowell Co., *L. E. A.* 9868; Transylvania Co., *L. E. A.* 8972. No. PIEDMONT: Alexander Co., *L. E. A.* 7586, 7611; Davidson Co., *L. E. A.* 9211; Durham Co., *Blomquist* 7588, 8747, 8749, *Bryan* Cyt.-296; Forsyth Co., *Schallert* M1224; Franklin Co., *E. S. Beaven* 380; Granville Co., *L. E. A.* 2167, *W. T. Batson* 751, 754, 755; Iredell Co., *L. E. A.* 3544; Orange Co., *Blomquist* 7064; Randolph Co., *L. E. A.* 2351, 9227; Surry Co., *R. Williams* 570, *L. E. A.* 5748; Vance Co., *L. E. A.* 2113; Wake Co., *L. E. A.* 3601; Warren Co., *L. E. A.* 2099. So. PIEDMONT: Catawba Co., *L. E. A.* 3474; Cleveland Co., *L. E. A.* 2582, *W. L. Culberson* 5500; Gaston Co., *L. E. A.* 2522, 9265; Montgomery Co., *L. E. A.* 4857; Polk Co., *L. E. A.* 7827, 7828; Rowan Co., *L. E. A.* 9185; Rutherford Co., *L. E. A.* 2636, 2678; Union Co., *L. E. A.* 4879. No. COAST.: Hertford Co., *L. E. A.* 5703. So. COAST.: Anson Co., *L. E. A.* 4991; Lee Co., *L. E. A.* 4738; Moore Co., *L. E. A.* 4798; Johnston Co., *L. E. A.* 3625. Widely distributed throughout the state, this is the most common species of *Orthotrichum*. It is essentially a species of the Piedmont, where it forms a characteristic part of the moss flora of the deciduous forest, especially in bottomlands and along streams. It seems to have a special affinity for ironwood (*Carpinus caroliniana* Walt.) on which it is found associated repeatedly with *Cryphaea glomerata* Schimp. and *Clasmatodon parvulus* (Hampe) Sull. I have also found these same three species associated together on cedar trees (*Juniperus virginiana* L.).

ORTHOTRICHUM PUMILUM Dicks. Bark of hardwoods. So. MTS.: Cherokee Co., bark of sugar maple along city street, Murphy, *L. E. A.* 8106, August 14, 1948. No. PIEDMONT: Forsyth Co., trunk of apple tree along village street, Kernersville, alt. 1000 ft., *L. E. A.* 12587, Aug. 31, 1953. This is a northern species which ranges south to Tennessee, North Carolina and Virginia. It has a close resemblance to *O. pusillum* and could easily be mistaken for that species. The capsules of the latter, however, are smooth and scarcely plicate when old and empty, and the exothecial

cells are poorly differentiated in longitudinal bands. The capsules of *O. pumilum* are clearly plicate and the exothecial cells are distinctly differentiated into longitudinal bands eight cells wide. Both species have typically soft, dark-green or blackish leaves, broad and obtuse, and apiculate or slightly toothed at extreme apex. The capsules tend to be ovoid; a characteristic that distinguishes these two species from the related *O. stellatum* and *O. ohioense*.

ORTHOTRICHUM PUSILLUM Mitt. Bark of trees. No. PIEDMONT: Alexander Co., *L. E. A.* 7611; Davidson Co., *L. E. A.* 9156; Durham Co., *Blomquist* 298, *Bryan* Cyt.-290, Cyt.-293, *E. F. Jones* '52; Forsyth Co., *Schallert* '36; Surry Co., *L. E. A.* 7810. So. PIEDMONT: Gaston Co., *Bryan* Cyt.-425; Iredell Co., *L. E. A.* 9185, 9188; Rutherford Co., *W. L. Culberson* 5559. No. COAST.: Hertford Co., *L. E. A.* 5688b; Martin Co., *L. E. A.* 6536. Nearly all of the collections of this species from North Carolina came from trees along city streets or at least near habitation. The species is almost always associated with *Tortula pagorum, Fabronia ciliaris, Leucodon julaceus, Clasmatodon parvulus* and various species of *Frullania*. Sometimes *O. pusillum* produces propagula, as do all of the Eastern American members of the "Orthotricha straminea" group, except perhaps *O. ohioense*.

ORTHOTRICHUM STELLATUM Brid. On the bark of trees. No. MTS.: Alleghany Co., *L. E. A.* 7634; Ashe Co., *L. E. A.* 5880, 7692; Burke Co., *L. E. A.* 4402. So. MTS.: Clay Co., *L. E. A.* 8071, 8072; Graham Co., *L. E. A.* 8154, 8161, 8164; Jackson Co., *L. E. A.* 423, 7891, 9922; McDowell Co., *L. E. A.* 3072; Transylvania Co., *L. E. A.* 8971. No. PIEDMONT: Alexander Co., *L. E. A.* 7585, 7586a; Chatham Co., *L. E. A.* 2265; Durham Co., *Blomquist* 8749; Surry Co., *R. Williams* 570a. So. PIEDMONT: Union Co., *L. E. A.* 4889. No. COAST.: Dare Co., *L. E. A.* 6510; Hertford Co., *L. E. A.* 5697. So. COAST.: Carteret Co., *L. E. A.* 6713a; Harnett Co., *L. E. A.* 9663. It is curious that *Orthotrichum stellatum* is distributed throughout North Carolina, for it is essentially a northern species and extends no farther south apparently than Georgia. Nearly all northern species of mosses whose ranges cease short of the Gulf of Mexico range southward only in the Appalachians and rarely extend below the upper Piedmont. The Dare Co. collection of *O. stellatum*, however, came from the bark of live oaks (*Quercus virginiana* Mill.) in the maritime forest immediately behind the high sand dunes which are no more than a quarter of a mile from the ocean. The species is more frequent in the mountains, but I have never collected it at high altitudes. It is more apt to be found at elevations about 2500 ft. and usually

along streams. Perhaps at higher altitudes it is replaced by *Ulota*. *Orthotrichum stellatum* is not a common moss, however, anywhere in the state.

ORTHOTRICHUM STRANGULATUM P. Beauv. On limestone. No. MTS.: Madison Co., *L. E. A.* 2930, 2935, 2984, 2990. So. MTS.: McDowell Co., *L. E. A.* 3016, *Anderson & Jones* 9695. Apparently the limestone outcrops in North Carolina are too limited in the amount of rock exposed at any one place for this moss to become abundantly established. I have found it only in small quantity at each of the localities from which it is known. It is notably absent from the several limestone outcrops in the Piedmont of North Carolina and from other outcrops in the Mountains. I am at a loss to explain its absence, for instance, in the Nantahala Valley in the extreme western part of the state, where there are a half-dozen or so outcroppings of limestone.

ULOTA CRISPA (Hedw.) Brid. Bark of trees, both hardwood and coniferous. No. MTS.: Alleghany Co., *L. E. A.* 5803; Ashe Co., *L. E. A.* 9639a; Avery Co., *L. E. A.* 4027, *Anderson & Jones* 9524; Burke Co., *L. E. A.* 4403; Mitchell Co., *L. E. A.* 4106, *Anderson & Jones* 9374, *A. G. Wetherby* '97 (Small, *Mosses of Southern U. S., No.* 48); Wilkes Co., *L. E. A.* 7478; Yancey Co., *L. E. A.* 7402, 10895. So. MTS.: Clay Co., *L. E. A.* 7994; Graham Co., *L. E. A.* 8111; Haywood Co., *B. McAllister* 190; Jackson Co., *L. E. A.* 498, 7892; Macon Co., *Correll & Correll* 7992, *L. E. A.* 4154, 9093, 11035, 11219, 12906, 12918; Swain Co., *L. E. A.* 3274; Transylvania Co., *Grout* '07, *L. E. A.* 8410, 8641. No. PIEDMONT: Alexander Co., *L. E. A.* 7584; Surry Co., *R. Williams* 581. So. PIEDMONT: Gaston Co., *L. E. A.* 9256; Montgomery Co., *L. E. A.* 4868. The occurrence of this essentially montane moss in the central Piedmont is somewhat surprising, although Grout (N. A. Flora 15A: 26. 1946) speaks of a collection of "*Ulota crispa* var. *crispula*" from Florida, which he regards as synonymous with *U. crispa*. In North Carolina, *Ulota crispa* is best developed in the transition forest between beech-maple and spruce-fir, which ordinarily is found between 5500 and 6000 ft. In Gaston Co., I collected it on the trunk of short-leaf pine (*Pinus echinata*) in a successional pine stand. The Montgomery Co. station is five miles east of Troy, well within the Piedmont; the plants grew on trunks of red maple (*Acer rubrum* L.) along a stream. The surrounding mosses in either station did not suggest a montane situation. At high altitudes in the Smoky Mts. on the trunks and branches of fir [*Abies fraseri* (Pursh.) Poir], I have collected a form with larger capsules that are not contracted under

the mouth when dry. This form agrees reasonably well with *U. crispa* var. *intermedia* (Schimp.) Grout, but the variety is scarcely worthy of taxonomic rank.

ULOTA HUTCHINSIAE (Sm.) Hamm. [*Ulota americana* (P. Beauv.) Limpr.] On non-calcareous rocks. No. Mts.: Alleghany Co., *L. E. A. 7768*; Ashe Co., *L. E. A.* 5845, *Correll* & *McDowell* 10848; Avery Co., *L. E. A.* 3988; Burke Co., *Small* & *Heller* '91; Mitchell Co., *Anderson* & *Jones* 9392; Wilkes Co., *L. E. A.* 5911; Yancey Co., *L. E. A.* 12757. So. Mts.: Haywood Co., *B. McAllister* 175, *G. F. Beaven* 365; *L. E. A.* 408, 11137; Jackson Co., *L. E. A.* 4246, 10722; Macon Co., *L. E. A.* 11044, 11242, 12943; McDowell Co., *L. E. A. 7447*; Transylvania Co., *L. E. A.* 8402, Grout '07. No. PIEDMONT: Surry Co., *R. Williams* 591; Granville Co., *W. T. Batson* 913. Although more abundant at high altitudes, this species occurs in the gorges along the Blue Ridge Escarpment and on Pilot Mt., Surry Co., in the upper Piedmont. In North Carolina, there are two forms of *Ulota hutchinsiae* on rocks. One is caespitose with stems relatively short and stocky and leaves that are rather loosely imbricate; the second form occurs in rather loose mats and the stems are long and slender with tightly imbricated leaves that tend to be slightly twisted. The latter form tends to be blackish while the caespitose form is a dark green.

ULOTA HUTCHINSIAE var. RUFESCENS (E. G. B.) Par. On bark of trees, both hardwoods and conifers. No. Mts.: Mitchell Co., *Schallert* '36; Watauga Co., *L. E. A.* 12719a; Yancey Co., *L. E. A.* 12775. So. Mts.: Haywood Co., *L. E. A.* 11111a; Swain Co., *Grout* '34, *Blomquist* 3. I am somewhat doubtful of the distinctness of this variety. It differs morphologically in no particular way from the species, and were it not for its unique substrate and distinctive habitat, I would be inclined not to recognize it taxonomically. The var. *rufescens* apparently is restricted to mountain gaps at high elevations, and seems to have an especial affinity for beech trees. Consequently, it is found in abundance in the beech orchards located next to the spruce-fir zone at about 5500 ft. and above in the Appalachians. The best development of var. *rufescens* that I have seen is on the slope above the east gap of Richland Balsam Mt. in the Caney Fork Balsams southeast of Sylva, Jackson Co., at an altitude of about 6000 ft. The forest is predominently beech and maple interspersed with an occasional spruce and fir. Robust colonies of var. *rufescens* occur on the trunks of the beech in association with *Paraleucobryum longifolium* (Hedw.) Loeske, *Zygodon viridissimus* (Dicks.) R. Br., *Anomodon rugelii* (C. M.) Keissl., *Ulota crispa*, *U. ludwigii*, *Homalatheciella subcapillata*

(Hedw.) Card., *Orthotrichum ohioense*, *Frullania asagrayana* Mont. and *Metzgeria crassipilis* (Lindb.) Evans. At Newfound Gap, in the Smoky Mts., and on Roan Mt., I have collected *Ulota americana* var. *rufescens* intermixed with both *Grimmia apocarpa* and *Hedwigia ciliata!* Both collections came from the trunks of beech trees.

The morphological distinctions listed by Britton (Bull. Torr. Bot. Club 21: 69. 1894) for this variety are very weak. The only characters of any possible consequence might be the more dense and obscure leaf cells, lack of linear or sinuose basal cells, and the pyriform capsule mentioned by Britton. Papillosity of the upper cells varies enormously, however, in the species, and I have observed robust rupestral forms with exceedingly dense and obscure upper cells. It is not unusual to find rectangular basal cells, even hyaline in some specimens, and the capsule shape is completely unreliable. The distinctiveness of the variety rests mainly on its unique ecology.

ULOTA LUDWIGII Brid. On hardwood and coniferous tree trunks and branches. No. Mts.: Ashe Co., *Anderson & Jones* 9636; Avery Co., *L. E. A.* 7461; Yancey Co., *L. E. A.* 10931. So. Mts.: Clay Co., *L. E. A.* 10661; Haywood Co., *G. F. Beaven* 361; Macon Co., *L. E. A.* 4158, 11035, 12907, 12918; Transylvania Co., *Grout* '07. Specimens of this species nearly always contain admixtures of *U. crispa*, but I have observed numerous pure colonies of *U. ludwigii* on the trunks and branches of mountain ash (*Sorbus americana* Marsh.) near the top of Mt. Mitchell, at about 6600 ft. elevation. I have collected it on beech in remnants of a hemlock-hardwood forest at about 3800 ft. near Highlands, Macon Co., but I have not seen it at lower altitudes.

AMPHIDIUM MOUGEOTII (Bruch) Schimp. On moist rocks, often on shaded ledges of vertical cliffs rising above streams or near waterfalls. No. Mts.: Ashe Co., *Anderson & Jones* 9613, 9617. So. Mts.: Jackson Co., *L. E. A.* 10002, 10587, 10596, 19625; Macon Co., *L. E. A.* 7952, 10316, 12836; Transylvania Co., *L. E. A.* 9993. This species is infrequent in the state but seems to occur in abundance wherever it is found. In the Escarpment gorges in the southern Blue Ridge it grows abundantly on cliffs at nearly all of the numerous waterfalls that mark the course of streams from the divide to the Piedmont. There is an amazing resemblance between *Amphidium mougeotii* and *Anoectangium peckii* Sull., and they share the same habitats. In fact, several specimens that I collected along the East Fork of the Tuckaseegee River, Jackson Co., contain admixtures of these two mosses, a

fact that produced an impressive list of conflicting annotations on the packets. (I am indebted to Harold Robinson for discovering the admixture.)

ZYGODON REINWARDTII (Hornsch.) A. Br. No. MTS.: Alleghany Co., trunk of oak tree, oak-hickory woods, 6 miles west of Sparta, *L. E. A.* 5795, September 6, 1937. This is the only collection known of this widespread and polymorphous species from the U. S. It has been collected in Alaska and is known from Mexico, Guatemala, Costa Rica, the West Indies, South America, Pacific Islands, India and Africa (Bartram, Fieldiana, Bot. 25: 208. 1949). I have made several attempts to re-collect this species at the Alleghany Co. locality cited above, but without success. Extensive logging operations during the early 1940's, coupled with relocation of a principal highway, have thwarted efforts to find the exact locality of the original collection. It was made at an altitude of about 2800 ft. The plants are thoroughly intermingled with *Leucodon julaceus* (Hedw.) Sull., *Platygyrium repens* (Brid.) BSG, *Amblystegium varium* (Hedw.) Lindb., *Leskea gracilescens* Hedw. and a lichen identified by W. L. Culberson as *Parmelia rudecta* Ach. The distributional pattern of *Zygodon reinwardtii* has been discussed by Sharp (Amer. Midl. Nat. 21: 267-354. 1939).

ZYGODON RUFO-TOMENTOSUS E.G.B. *ex* Malta. On tree trunks, especially fir, less commonly on hardwoods in spruce-fir zone of the higher mountains, 5500 ft. altitude and above. No. MTS.: Avery Co., *L. E. A.* 4035; Yancey Co., *Anderson* & *Jones* 9443, 9478. So. MTS.: Haywood Co., *L. E. A.* 11186; Swain Co., *Sharp*, '34, '42, *L. E. A.* 3317; Transylvania Co., *Grout* '07. These collections represent poorly the distribution of this species in North Carolina, for it is to be found on nearly every fir tree at high elevations throughout the Mountains, occurring with such typical associates as *Leptodontium excelsum* (Sull.) E.G.B., *Herberta tenuis* Evans, *Frullania asagrayana* Mont., *Mylia cuneifolia* (Hook.) S. F. Gray, *Paraleucobryum longifolium* (Hedw.) Loeske, *Bazzania nudicaulis* Evans, *Dicranum montanum* Hedw., *Plagiochila tridenticulata* Tayl., *Ulota crispa* (Hedw.) Brid., *U. ludwigii* Brid. and *Brotherella delicatula* (James) Fleisch.

The epithet, *Zygodon rufo-tomentosus*, was originally applied by Mrs. Britton to plants which she and J. K. Small collected in southwestern Virginia, on White Top Mt., on branch of fir, alt. 5700 ft., May 29, 1892. The Virginia plants were originally identified as *Z. viridissimus* and reported under that name (Mem. Torr. Bot. Club 4: 180. 1893). Later, however, Britton con-

cluded that they might represent a new species and sent a specimen to Paris as *Z. rufo-tomentosus* ined., and it was so listed in Paris' *Index Bryologicus*, ed. *1* and *2*. In a subsequent article, however, Britton (THE BRYOLOGIST 11: 61-66. 1908) clearly rejected *Z. rufo-tomentosus* and referred the Virginia plants as she had done originally to *Z. viridissimus*. Malta (Latv. Bot. Dārza Darbi 1: 54. 1926) regarded *Z. rufo-tomentosus* worthy of specific rank and described it validly for the first time. Malta should, therefore, be credited as the authority for *Z. rufo-tomentosus*.

Malta recognized *Z. rufo-tomentosus* principally because of its distinctive capsule shape, which he described as "schlank, zylindrisch, langhalsig." This is in contrast to the "länglich-oval bis birnförmig, eng- und rotmündig" capsules of *Z. viridissimus*. In addition, the base of the stems of *Z. rufo-tomentosus* is densely clothed with bright red, nearly smooth radicles. Nearly all of the specimens of this species contain plants with at least some leaves that are distinctly serrate near the apex. This fact was emphasized by Patterson (THE BRYOLOGIST 53: 27-42. 1950), who states: "It might be noted that the species is described as having entire leaves, while our plants often have one or two sharp teeth on or near the shortly attenuate leaf apex." Some collections contain plants in which nearly all of the leaves are markedly serrate (*e.g., L. E. A.* 9478, from Mt. Mitchell, Yancey Co., N. C.) in which the teeth are as prominent as in *Z. reinwardtii* or *Z. campylophyllus*. On the other hand, some collections of *Z. rufo-tomentosus* contain plants that show no evidence of serrations, and in still others only an occasional leaf or perhaps now and then a perichaetial leaf will have one or more prominent serrations. All degrees of leaf serration occur. The capsules are not only long-cylindric with a prominent neck, as described by Malta, but they are distinctly contracted below the mouth. The capsules of North Carolina plants are even more noticeably cylindric than those from Virginia, and in a collection from the Caney Fork Balsam Mts., Haywood Co., N. C. (*L. E. A.* 11263) there are capsules that measure up to 2.5 mm. in length and less than 0.5 mm. wide. These differences, coupled with its unique habitat in the spruce-fir zone, are sufficient to regard it as an entity distinct from *Z. viridissimus*.

Malta has called attention to the remarkable resemblance between *Z. rufo-tomentosus* and a little known species, *Z. cylindricus* C. M., known only from the type collection obtained near Orizaba, Mexico, by Liebmann. Had Malta seen serrate-leaved material of *Z. rufo-tomentosus*, he doubtless would have been even more impressed by their resemblances, for *Z. cylindricus* is described in

part by Malta (*l.c.*, p. 135), who studied the type, as follows: "Blätter lineallanzettlich, zugespitzt, ganzrandig, nur die Perichaetialblätter hier und da an die Spitze gezähnt." This description also applies to much of our material of *Z. rufo-tomentosus*. The capsule of *Z. cylindricus* is described by C. Müller (Syn. I: 672. 1849) as follows: "theca in ped. elongato erecta, elongato-cylindrica, longicolla," which is the same as in *Z. rufo-tomentosus*. Specimens have been collected in Guatemala by both Standley and Steyermark which also bear a striking resemblance to the Southern Appalachian *Z. rufo-tomentosus*. The Guatemalan plants were originally identified by Bartram as *Z. liebmannii*, but Grout thought they belonged to *Z. reinwardtii* var. *subintegrifolius*, and were published by Bartram (Fieldiana: Bot. 25: 208. 1949) under that variety. Standley's No. 8453a, from the Dept. Totonicapán, Guatemala, is very similar to the more serrate-leaved of the Appalachian material. It is not within the scope of the present study to attempt to evaluate these similarities, but I feel compelled to call them to the attention of future investigators.

ZYGODON VIRIDISSIMUS (Dicks.) R. Br. On hardwood tree trunks, rarely on rocks. NO. MTS.: Ashe Co., *L. E. A.* 5868. SO. MTS.: Macon Co., *L. E. A.* 4171; Haywood Co., *L. E. A.* 11263; Jackson Co., *L. E. A.* 10620, 10712. I cannot agree with Malta (*l.c.*, p. 54) that all of the North American material of *Zygodon viridissimus* belongs to var. *rupestris* Lindb. (var. *vulgaris* Malta). At lower altitudes, between 3000 and 5500 feet there occurs on hardwoods in North Carolina, a somewhat reduced form of *Z. viridissimus* with short stems almost lacking in radicles and leaves becoming smaller toward the base of the stem. The leaves are widely spreading and recurved when moist. In leaf shape, these plants resemble *Zygodon conoideus* (Dicks.) Hook. & Tayl., and Grout (THE BRYOLOGIST 11: 25-30. 1908) went so far as to identify material from Chestnut Bald, Transylvania Co., N. C., as that species, although he added the notation "Determination somewhat doubtful," and later changed his mind and referred all of his North Carolina collections rightly to *Z. viridissimus*. All of the North Carolina plants vary enormously in leaf shape, length of the terminal leaf cell, amount of tomentum and in the size and shape of the propagula. I collected a curious form on a partially decayed log near a waterfall on the East Fork of the Tuckaseegee River, Jackson Co. (*L. E. A.* 10620) in which the stems are long and slender, the leaves very short and broad, distant, scarcely recurved, and with propagula only three cells long and measuring

only 40 μ long × 15 μ wide. The same form grew nearby on moist rocks.

ZYGODON VIRIDISSIMUS var. RUPESTRIS Lindb. (*Z. viridissimus* var. *vulgaris* Malta). On hardwood tree trunks, decaying logs, moist rocks. So. MTS.: Macon Co., *L. E. A.* 9051, 10391; Transylvania Co., *Grout* '07. These plants match very closely the Macoun collections from Victoria Island, Canada (*Canadian Musci* 303) and the Cascade Mt. collection from Washington (Allen, *Mosses of the Cascade Mts.* No. 46), although our material is not quite as robust. The var. *rupestris* is unquestionably a weak entity, but can be distinguished by narrower leaves, gradually tapering to a long, slender apex, terminating in a long apical cell. According to my observations, the leaf cells of var. *rupestris* are more densely papillose than in the species. Capsules have not been observed in the variety.

DRUMMONDIA PROREPENS (Hedw.) Jenn. On the trunks and branches of trees, almost entirely confined to hardwoods. No. MTS.: Alleghany Co., *L. E. A.* 8205; Ashe Co., *L. E. A.* 5867, *Anderson* & *Jones* 9602; Burke Co., *L. E. A.* 4401; Mitchell Co., *Anderson* & *Jones* 9383; *Anderson* & *Robinson* 13060; Wilkes Co., *L. E. A.* 5902, 7477. So. MTS.: Buncombe Co., *L. E. A.* 844; Cherokee Co., *L. E. A.* 8109; Graham Co., *L. E. A.* 8119; Haywood Co., *Grout* '07, *G. F. Beaven* M359; Jackson Co., *L. E. A.* 4259, 9942, 10714; Macon Co., *L. E. A.* 4155, 11218; Polk Co., *L. E. A.* 7830; Swain Co., *L. E. A.* 2827; Transylvania Co., *L. E. A.* 7831. No. PIEDMONT: Alexander Co., *L. E. A.* 7562; Chatham Co., *L. E. A.* 2273; Durham Co., *Blomquist* '30; Forsyth Co., *Schallert* '20; Guilford Co., *Correll* 8661; Orange Co., *Correll* 8621; Randolph Co., *L. E. A.* 2354, 7325; Surry Co., *R. Williams* 411, *L. E. A.* 5749; Vance Co., *L. E. A.* 6119; So. PIEDMONT: Gaston Co., *L. E. A.* 2521, 9258, Rowan Co., *L. E. A.* 2458, 9190. No. COAST.: Hertford Co., *L. E. A.* 5690. So. COAST.: Harnett Co., *L. E. A.* 9664. This species is a constant associate of the oak-hickory forest and reaches its best development where chestnut oak forms the dominant oak. In the mountains this occurs on relatively low ridges and in gaps, while in the Piedmont, the best development of chestnut oak, and consequently *Drummondia prorepens*, is found on the scattered, monadnock-type hills or low "mountains." It also grows on beech along streams or moist flats. In the Coastal Plain, *D. prorepens* is evidently not common.

MACROCOMA HYMENOSTOMUM (Mont.) Grout. (*Macromitrium sullivantii* C. M.) Bark of pine and cedar trees, more rarely

on hardwoods. So. Mts.: Clay Co., *L. E. A.* 10662; Jackson Co., *L. E. A.* 3234, 3239, 9944, 10641; Macon Co., *L. E. A.* 10433, 11250; Transylvania Co., *L. E. A.* 4266, 8409, 8962, 9009, 11111, 12948. This moss has been known previously in the U. S. from a single locality, Jonah or Bear Mt., Georgia, where Lesquereux collected it on the bark of old pine trees. From these plants C. Müller described *Macromitrium sullivantii* (Bot. Zeit. 20: 361. 1862), and they were issued in both ed. 1 and ed. 2 of Sull. & Lesq., *Musci Bor. Am.*, 128 and 193, respectively. Grout (N. A. Flora 15A: 42. 1946) pointed out that the plants belong to *Macrocoma hymenostomum*, which is widely distributed in Mexico, Central and South America. In the U. S., this species is restricted to a very small area of the Southern Appalachians, centering around the Southeastern Escarpment of the Blue Ridge, approximately at the boundary of the three states, North Carolina, South Carolina and Georgia. Apparently *M. hymenostomum* has rather precise habitat requirements. It is found in abundance only on mountain peaks or slopes covered with scrub pine, scrub cedars and a considerable amount of exposed rocks. On cedars in mats or islands of vegetation on large exposed granitic slopes it occurs in enormous abundance, completely clothing the smaller branches and growing on the trunks, crowding out and excluding such notorious competitors as *Leucodon julaceus* (Hedw.) Sull., *L. brachypus* Brid., *Frullania* spp., *Haplohymenium triste* (Ces.) Kindb. and *Pylaisia selwynii* Kindb. Sometimes it is associated with the lichen, *Sticta weigelii* (Ach.) Vain., which W. L. Culberson has kindly identified. On the dry mixed hardwood-pine slopes of the Blue Ridge Escarpment it occurs in much less abundance, but I believe it grows sparsely throughout the limited southern exposure of the Escarpment, extending from Tryon, North Carolina, to the northeastern corner of Georgia. I have collected *Macrocoma hymenostomum* in several places along the Escarpment of both South Carolina and Georgia. It fruits prolifically, the capsules maturing in midsummer.

Schlotheimia lancifolia Bartr. Bark of hardwoods. So. Mts.: Jackson Co., *L. E. A.* 81, 10094; Macon Co., *Sharp* 151 (type in herb. Bartram), '31, *Sharp & Wagner* 1450, *L. E. A.* 11232. This rare Southern Appalachian endemic was known previously only from the type locality, which is Ravenel's Forest, near Highlands, Macon Co., N. C. This once magnificent forest of mixed hemlock and hardwoods was cut about 15 years ago for paper pulp, but the Wright family of Highlands has preserved a small tract consisting of a few acres and the Howell Tract, owned

by the Highlands Biological Station, contains remnants of the original forest. *Schlotheimia lancifolia* can still be found in some abundance scattered among these isolated and preserved tracts. It is one of our rarest mosses.

SCHLOTHEIMIA RUGIFOLIA (Hook.) Schwaegr. (*S. sullivantii* C. M.) Tree trunks, often high off the ground, fallen logs, rarely shrubs. So. MTS.: Jackson Co., *L. E. A.* 7877; Macon Co., *L. E. A.* 10432; Transylvania Co., *L. E. A.* 8292, 8319, 8421, 9011, 9980, 11091, 11099, 11130. NO. COAST.: Tyrrell Co., *L. E. A.* 6083. SO. COAST.: Brunswick Co., *Blomquist* & *Correll* 9464; Columbus Co., *L. E. A.* 8242, *Blomquist* 10136, *Anderson* & *Evans* 6185; Harnett Co., *E. F. Jones* 437; Moore Co., *G. M. Tees* 1200; Pender Co., *L. E. A.* 3915, *Anderson* & *Evans* 6712; Scotland Co., *L. E. A.* 5073. This species, widely distributed in Mexico, Central and South America and the West Indies, is common in Florida, along the Gulf Coast, and in the Coastal Plain north to Virginia. It occurs as a disjunct in the Southern Appalachians, where its distribution coincides almost exactly with that of *Macrocoma hymenostomum*, although the latter has not yet been found in Tennessee. *Schlotheimia rugifolia* is most abundant in the deep Escarpment Gorges of the extreme southeastern Blue Ridge, where it abounds on the trunks of hardwoods along the streams. It is found at the base of the Escarpment where the streams empty into the Piedmont, but does not extend beyond the shadows of the scarp. It is entirely absent from the Piedmont proper. In the Coastal Plain, *S. rugifolia* is a plant of swamps and steams, where it is abundant on trunks of swamp trees, especially cypress, white cedar and gum. It becomes less and less common northward in the Coastal Plain, although I have observed it in abundance in the Great Dismal Swamp of Virginia.

I have made detailed morphological comparisons between colonies of *Schlotheimia rugifolia* from the mountains and those from the Coastal Plain, including measurements of leaves, leaf cells, capsules, peristome, etc., but there are no detectable differences. Recently I have made reciprocal transplants, in which plants from a swamp in Whiteville, Columbus Co., were exchanged with plants from the Ravenel Forest, near Highlands, Macon Co. It is too early yet to observe results, but the transplants are being watched with much interest, and the results will be published later.

(TO BE CONTINUED)

MOSSES OF NEVADA[1]

ELVA LAWTON[2]

Nearly all of Nevada lies within the Great Basin of western North America, a region with numerous short mountain ranges running north and south and alternating with broad dry valleys. Approximately half of the area of the state consists of these arid valleys, while the other half, containing the foothills and mountains is the region of greatest rain and snow fall and contains all the forest land. A large part of the land at the higher elevations is set aside as parts of the National Forests and practically all the bryophytes reported here have been collected in or near these forests.

Nevada lies between 35° and 42° north latitude and between 114° and 120° west longitude. It is 484 miles long and 321 miles wide at the extremities, contains 110,540 square miles, and is one of the largest states, ranking sixth in size.

The altitude ranges from 13,145 feet on Boundary Peak in the west and 13,061 feet on Mt. Wheeler in the east down to about 800 feet near the Colorado River in the southern part of the state. The average elevation is approximately 5500 feet, but there are at least 25 mountains over 10,000 feet in height. In the central and northern parts of the state the valleys vary in elevation from 3800 feet in the west to 6000 feet in the east.

The average annual precipitation is only 8.8 inches, and the amount depends not only on the elevation but also on the position in relation to the mountains, with the greatest fall on the eastern slopes of the Sierra Nevada Mountains in the western part of the state. In the southern desert regions the rainfall ranges from two to ten inches per year. The heaviest average annual precipitation of approximately 18 to 29 inches occurs in the mountains from the yellow pine belt through the spruce-fir belt.

The bryophyte flora of Nevada has received very little study, probably because it is generally considered to be a desert region and therefore a poor place to look for mosses. The first collection was made by Sereno Watson in 1867 and 1868 at the time the first Pacific Railroad was built and in connection with the Geological Survey of the Fortieth Parallel. In 1902 C. F. Baker collected in western Nevada some mosses which were reported by Cardot and Thériot (1904), and several other botanists have

[1] This work was made possible by a grant from the Anderson Research Fund of the University of Washington and by a grant from the Biological and Medical Research Fund of the State of Washington.

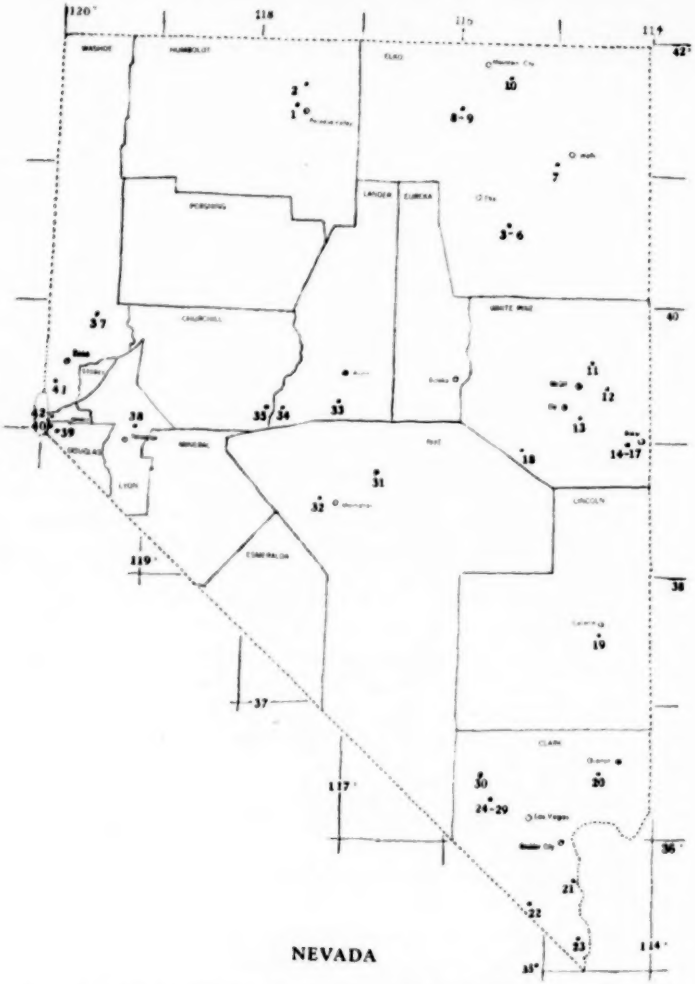
[2] Hunter College of the City of New York, New York 21, N.Y.

picked up a few specimens from time to time. In general Watson collected between 39° and 42° north latitude along the route of the railroad which follows the Humboldt River, but according to the report of the survey, the party went from Unionville to Battle Mountain and from there to Austin where they took the overland stage to Fort Ruby, and apparently no mosses were collected between Unionville and the Ruby Mountains. The localities for Watson's mosses are given here as the data appears on the specimens except that county names have been added where it is possible to be sure of the county. Modern maps give the name Ruby Mountains to the range he called East Humboldt, and the Clover Mountains are now called the East Humboldt Range.

Sereno Watson's mosses were identified by Thomas P. James whose report gives 96 species and varieties from the Great Basin of Utah and Nevada, with 68 from Nevada. The first set of these specimens was placed in the United States National Herbarium at Washington, D.C., with the other sets, some incomplete, distributed to other institutions. The specimens at the United States National Herbarium and those at the New York Botanical Garden were examined, and all but nine of the 68 reported were found. However eight were in such poor condition that it was not possible to be sure of the identifications. Apparently James gave the same number to all collections of any one species, and as a result, six species reported as from Nevada were from Utah in the sets examined. A total of 45 species and varieties from James' list have been checked and are included in this report, but a few appear under other names owing to incorrect identifications in the original report. Twenty-five of the additional species reported by James from Utah and Nevada have been found in Nevada by later collectors.

An eight-week trip during the summer of 1955 under the auspices of the University of Washington was made to Nevada to collect bryophytes. The hepatics collected on this trip have been identified by Dr. Lois Clark (1957). Most of the collecting was done at altitudes between 6200 feet and 8500 feet, the regions where the precipitation is greatest, but some collections were made at lower elevations in the desert regions. As a result of this work 80 species and varieties are here reported from the state for the first time. Thirteen species and varieties which were collected by Watson have not been found again in Nevada. In 1955 collections were made in 12 of the 17 counties, and there are reports of collections from two of the other five counties. Sereno Watson collected about a dozen species in Pershing County, and T. C. Frye

found two species in Eureka County. No mosses are reported from Storey, Mineral and Esmeralda Counties. No corticolous mosses were found, and very few specimens were collected on rotten wood. *Pohlia nutans* and *Orthotrichum cupulatum* were



MAP. 1. Map of the state of Nevada, showing places visited during the 1955 collecting season. Each collecting site is represented by a number here and in the text.

each found once on decaying wood, a few collections of *Dicranoweisia* were from rotten logs, and some specimens of liverworts were found on logs. At least three-fourths of all the mosses collected were found on relatively dry rocks, in rock crevices or on rocks bordering streams. The remaining collections were from soil, often rather rocky soil. *Philonotis fontana* was by far the most abundant of the species growing on soil. *Funaria hygrometrica, Ceratodon purpureus, Pohlia nutans* and *Bryum argenteum*, four of the most abundant and widespread mosses in North America were all found in Nevada, but they were neither common nor plentiful.

Collections were made in four vegetation zones and the principal species found in the zones are listed below, but there is considerable overlapping of species in the different zones. *Grimmia anodon* and *Tortula ruralis* were found in all vegetation belts, and *Grimmia calyptrata* was present in all except the *Covillea* zone. Most of the mosses found in the juniper-pinyon pine belt were also found at higher elevations.

The *Covillea* or southern desert zone is in the extreme southern part of the state, south of the thirty-seventh parallel, along the Colorado River at altitudes under 3000 feet where the average annual rainfall is less than 10 inches. Only three genera are represented in the following list and the mosses were found in small quantities.

Grimmia affinis
Grimmia anodon
Grimmia laevigata
Grimmia wrightii
Tortula aurea
Tortula ruralis
Crossidium griseum

The *Artemesia* or northern desert zone is, for the most part, north of the thirty-seventh parallel and occupies large areas at elevations up to 6000 feet and has a little more rainfall than the *Covillea* belt. A larger number of species and larger quantities of moss were found, but as in the *Covillea* belt the Grimmias and Tortulas were dominant.

Grimmia anodon
Grimmia apocarpa
Grimmia calyptrata
Grimmia ovalis
Grimmia pulvinata
Pottia nevadensis
Pterigoneuron ovatum
Tortula bistratosa
Tortula obtusissima
Tortula papillosissima
Tortula princeps
Tortula ruralis
Encalypta vulgaris var. *mutica*

Pseudoleskeella tectorum, Bryum turbinatum and *Homalothecium nevadense* were found occasionally in the damper spots of the *Artemesia* belt.

The juniper-pinyon pine belt occupies the foothills of the mountains from about 5000 feet to 6500 feet. The moss vegetation in this belt is of two distinct types depending on the amount of moisture.

(a) species found in relatively drier situations:

Grimmia anodon
Grimmia calyptrata
Encalypta vulgaris var. *mutica*
Tortula papillosissima
Tortula ruralis
Orthotrichum alpestre var. *occidentale*

(b) species found along streams:

Amblystegium americanum
Amblystegium compactum
Brachythecium rutabulum
Cratoneuron filicinum
Didymodon tophaceus
Leptodictyum trichopodium
Mercya latifolia

The yellow pine and aspen-fir belts from 6200 feet to about 8500 feet receive the most rain and snow, and here the largest number of species and the greatest quantities of bryophytes were found. The most common mosses are as follows:

Bryum (12 spp.)
Orthotrichum (10 spp.)
Grimmia (7 spp.)
Mnium (4 spp.)
Pohlia (4 spp.)
Tortula (4 spp.)
Cratoneuron (3 spp.)
Brachythecium (2 spp.)
Dicranoweisia crispula
Encalypta vulgaris v. *mutica*
Homalothecium nevadense
Hypnum revolutum
Philonotis fontana
Pseudoleskeella tectorum

In the higher altitudes of the fir-spruce belt at Angel Lake, Baker Creek, Lemoille Canyon and Deer Creek Canyon, a few sub-alpine species were found; *Desmatodon latifolius*, *Distichium capillaceum*, *Distichium inclinatum* and the liverworts, *Asterella ludwigii* and *Asterella saccata*.

Bartram (1945) reported a new species, *Weisia sweetii*, from Yant Pit Canyon in the Virgin Mountains of Clark County, Nevada. Cardot and Thériot (1904) reported *Webera chlorocarpa* from Washoe County, Nevada. According to Andrews (1935), the type material of this species is in the herbarium of the New York Botanical Garden and is hardly separable from forms of *Pohlia drummondii*. According to Crum and Anderson (1955) *Physcomitrium megalocarpum* was found in Nevada by Palmer. No doubt there are additional reports of mosses from Nevada which did not come to my attention and it is hoped that future collections in the state will add to the list.

The specimens collected in 1955 are deposited in the herbarium of the University of Washington. The collections made at other times by various botanists may be found in the herbaria indicated by the standard abbrevia-

tions: United States National Herbarium (US); New York Botanical Garden (NY); University of Washington (WTU). With a few exceptions the nomenclature and systematic arrangement of the species in the following list is that of Grout (1940). To avoid repetition of data, a number is assigned to each of the 42 collecting areas for 1955. The data for each area are given in the following numbered list, and the areas are indicated on the map by these same numbers. In the list of species the number of the collecting area, in parentheses, precedes the specimen number.

HUMBOLDT CO., SANTA ROSA MTS., HUMBOLDT NATIONAL FOREST. (1) Between Paradise Valley and Hinkey Summit, alt. about 5000 ft., June 11, 1955. Nos. *2605-2610*. (2) North of Hinkey Summit near Martin Creek Guard Station, alt. 7000 ft., June 11-12, 1955. Nos. *2611-2625*.

ELKO CO., RUBY MTS., HUMBOLDT NATIONAL FOREST. (3) Thomas Canyon near junction with Lemoille Canyon, alt. 7600 ft., June 14, 1955. Nos. *2626-2650*. (4) Lemoille Canyon, 5 mi. from Thomas Canyon near Harrison Guard Station, alt. 8000 ft., June 15, 1955. Nos. *2651-2662*. (5) Lemoille Canyon between Thomas Canyon and Harrison Guard Station, alt. 7800 ft., June 16, 1955. Nos. *2663-2680*. (6) Lemoille Canyon, west of entrance to Thomas Canyon near Boy Scout Camp, June 17, 1955. Nos. *2681-2682*. (7) Angel Lake, alt. 8000 ft., June 18-19, 1955. Nos. *2683-2704*.

INDEPENDENCE MTS. (8) Humboldt National Forest, about 36.5 mi. southeast of Mountain City, west of Jack Creek Guard Station, along the creek, alt. 6500 ft., June *22*, 1955. Nos. *2705-2715*. (9) Schoonover Creek near junction with Jack Creek at entrance to Humboldt National Forest, alt. 6500 ft., June *22*, 1955. Nos. *2716-2723*.

HUMBOLDT NATIONAL FOREST. (10) Gold Creek Ranger Station southeast of Mountain City, alt. 6670 ft., June *23*, 1955. Nos. *2724-2731*.

WHITE PINE CO., SCHELL CREEK RANGE, NEVADA NATIONAL FOREST. (11) East Creek Campground northeast of McGill, alt. 7400 ft., June *26*, 1955. Nos. *2732-2746*. (12) Timber Creek Campground east of McGill, alt. 8200 ft., June *27-28*, 1955. Nos. *2747-2781*. (13) Southeast of Ely near Success Summit, alt. about 8000 ft., June *28*, 1955. Nos. *2782-2786*.

SNAKE MTS., NEVADA NATIONAL FOREST. (14) Lehman Creek Campground west of Baker and northwest of Lehman Caves, alt. 8000 ft., June 30, 1955. Nos. *2787-2798*. (15) Baker Creek west of Baker, about 1 mi. south of Lehman Caves, alt., 7000 ft., July 1, 1955. Nos. *2799-2804*. (16) Baker Creek west of Snow Cabin, alt. 7500-9000 ft., July *2-3*, 1955. Nos. *2805-2853*. (17) Snake Creek Campground southwest of Baker, about 12 mi. from Nevada-Utah state line, near old miner's cabin, alt. 7500 ft., July 4-5, 1955. Nos. *2854-2897*.

WHITE PINE MTS., NEVADA NATIONAL FOREST. (18) White River Campgrounds southwest of Ely and south of Ellison Ranger Station, along White River, alt. 7000 ft., July 7, 1955. Nos. *2898-2907*.

LINCOLN CO. (19) Ryan-Kershaw State Park south of Caliente, alt. 4500 ft., July 8, 1955. Nos. *2908-2915*.

CLARK CO. (20) Valley of Fire State Park, Lake Mead Recreation Area, southwest of Overton, alt. about 1500 ft., July 9, 1955. Nos. *2916-2919*. (21) Lake Mead National Recreation Area, Eldorado Canyon east of Nelson near Colorado River, alt. about 1200 ft., July 11, 1955. Nos. *2920-2924*. (22) About 12 mi. west of Searchlight on route 68, 4 mi. east of Nevada-California state line, July 11, 1955. Nos. *2925-2926*. (23) Lake Mead Na-

tional Recreation Area about 10 mi. northwest of Davis Dam, alt. about 2500 ft., July 12, 1955. Nos. 2927-2929.

CHARLESTON MTS., TOIYABE NATIONAL FOREST (formerly Nevada National Forest). (24) Deer Creek Canyon, alt. 8300 ft., July 13, 1955. Nos. 2930-2940. (25) Lee Canyon along trail south of Lee Guard Station, alt. 8400 ft., July 14, 1955. Nos. 2941-2946. (26) Lee Canyon, 3.2 mi. northeast of McWilliams Camp, alt. 8400 ft., July 14, 1955. Nos. 2947-2949. (27) Along road from Lee Canyon to Deer Creek, alt. 8300 ft., July 14, 1955. Nos. 2950-2957. (28) Kyle Canyon, trail to Mt. Charleston, alt. 7800 ft., July 15, 1955. Nos. 2958-2669. (29) Kyle Canyon near Ranger Station, alt. 7800 ft., July 15, 1955. Nos. 2970-2971. (30) Cold Creek Campground, 2 mi. southwest of Cold Creek Patrol Station, about 13 mi. southwest of Indian Springs, alt. 6200 ft., July 16, 1955. Nos. 2972-2981.

NYE CO., TOIYABE NATIONAL FOREST. (31) Toquima Range, Pine Creek Campground east of Mt. Jefferson, alt. 6-7000 ft., July 18, 1955. Nos. 2982-2995. (32) Toiyabe Range west of Smoky Valley, about 7 mi. northwest of Manhattan on rocks near Peavine Campground, July 19, 1955. No. 2996.

LANDER CO. (33) Toiyabe National Forest, Toiyabe Range, Kingston Creek Campground, 2 mi. east of Kingston Creek Guard Station, about 15 mi. south of Austin, alt. 6500 ft., July 20-21, 1955. Nos. 2997-3016. (34) Route 50 about 4½ mi. east of Carroll Summit, 40 mi. southwest of Austin, alt. about 6500 ft., July 21, 1955. Nos. 3017-3019.

CHURCHILL CO. (35) Route 50 west of Carroll Summit, about 45½ mi. southwest of Austin, July 21, 1955. Nos. 3020-3023.

DOUGLAS CO., TOIYABE NATIONAL FOREST. (36) Clear Creek Campground, July 22, 1955. No. 3024.

WASHOE CO. (37) Pyramid Lake Indian Reservation, west side of lake where route 33 reaches lake, alt. 4000 ft., July 23, 1955. Nos. 3025-3034.

LYON CO. (38) Route 95A about 11 mi. east of Yerington, alt. 4400 ft., July 24, 1955. No. 3035.

DOUGLAS CO., TOIYABE NATIONAL FOREST. (39) Kingsbury Road, 3 to 4½ mi. east of Lake Tahoe, alt. about 7000 ft., July 25, 1955. Nos. 3036-3043. (40) Lake Tahoe about 7½ mi. north of Nevada-California state line, on rocks just north of Cave Rock, alt. 6300 ft., July 25, 1955. Nos. 3044-3067.

WASHOE CO. (41) Mt. Rose, route 27, east of summit in a mountain meadow, alt. 8000 ft., July 26, 1955. Nos. 3068-3099.

ORMSBY CO. (42) Lake Tahoe along route 28 about ½ mi. north of its junction with route 50, alt. about 6300 ft., July 27, 1955. Nos. 3100-3125.

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ARTIFICIAL KEY TO THE MOSSES OF NEVADA

1 Lvs. clearly 2-ranked..... 2
1 Lvs. not 2-ranked..... 4

2 Lvs. broad, split on inner edge at base and clasping stem.....*Fissidens grandifrons*
2 Lvs. filiform from a sheathing base, not split..... 3
3 Capsules erect and symmetric.....*Distichium capillaceum*
3 Capsules inclined and asymmetric.....*Distichium inclinatum*
4 Lvs. with filaments or lamellae on upper surfaces..... 5
4 Lvs. without outgrowths on upper surfaces..... 8
5 Lvs. to 2 mm. long, awned, with filaments on upper surfaces.....*Crossidium griscum*
5 Lvs. with lamellae on upper surfaces..... 6
6 Lamellae 4-6; lvs. about 1 mm. long; capsules without peristomes.....*Pterigoneuron ovatum*
6 Lamellae many; lvs. 8-10 mm. long; peristome of 64 short teeth.. 7
7 Calyptra conspicuously hairy; marginal cells of lamellae pear-shaped in cross section.....*Polytrichum juniperinum*
7 Calyptra with few hairs; marginal cells of lamellae not pear-shaped in cross section.....*Polytrichadelphus lyellii*
8 Calyptra longer than the erect capsule; lvs. lingulate and strongly papillose..... 9
8 Plants otherwise..... 11
9 Lvs. muticous.....*Encalypta vulgaris* var. *mutica*
9 Lvs. not muticous..... 10
10 Capsules furrowed; spores 35-55 μ.....*Encalypta rhabdocarpa*
10 Capsules smooth; spores 24-35 μ....*Encalypta vulgaris* var. *apiculata*
11 Sporophytes terminal; stems usually erect.....(Acrocarpi) 12
11 Sporophytes on short lateral branches; plants usually creeping and much branched.....(Pleurocarpi) 108
12 Capsules commonly present, without a peristome..... 13
12 Capsules with peristome or plants sterile..... 21
13 Plants growing on rocks..... 14
13 Plants growing on soil..... 17
14 Lvs. papillose; capsules symmetric..... 15
14 Lvs. smooth; capsules asymmetric, as broad as long, seta shorter than capsule.....*Grimmia anodon*
15 Capsules with 8 longitudinal ribs when dry.....*Amphidium lapponicum*
15 Capsules smooth..... 16
16 Leaf margins plane; operculum not persistent.....*Gymnostomum aeruginosum*
16 Leaf margins recurved below; operculum attached to exserted columella for a time.....*Gymnostomum recurvirostrum*
17 Lvs. usually strongly papillose, not awned.....*Pottia heimii*
17 Lvs. smooth..... 18
18 Costa usually excurrent to form an awn; capsules not globose or pyriform; columella attached to operculum.....*Pottia nevadensis*
18 Costa not excurrent; capsules globose or pyriform..... 19
19 Capsules immersed, seta about as long as capsule.....*Physcomitrium pygmaeum*
19 Capsules not immersed..... 20
20 Leaf margins reflexed, alar cells differentiated.....*Physcomitrium megalocarpum*
20 Leaf margins plane, alar cells not differentiated.....*Physcomitrium californicum*

21 Plants usually with asexual reproductive bodies..... 22
21 Plants without asexual reproductive bodies..... 25
22 Lvs. papillose..... 23
22 Lvs. not papillose..... 24
23 Basal leaf cells swollen; brood bodies leaf-like...*Aulacomnium palustre*
23 Basal leaf cells not swollen; brood bodies fusiform.....*Aulacomnium androgynum*
24 Lvs. spirally twisted and contorted.....*Grimmia torquata*
24 Lvs. not twisted and contorted.....*Pohlia annotina* var. *decipiens*
25 Plants dark green or blackish, growing on rocks..... 26
25 Plants green to light yellow-green, if blackish not on rocks..... 52
26 Leaf cells papillose..... 27
26 Leaf cells without papillae..... 40
27 Leaves crisped at least when dry..... 28
27 Leaves not crisped..... 29
28 Capsules ribbed, on short setae, without peristome.....*Amphidium lapponicum*
28 Capsules not ribbed, on long setae, peristomate.....*Dicranoweisia crispula*
29 Operculum attached to columella.....*Grimmia apocarpa* var. *gracilis*
29 Operculum free from columella..... 30
30 Stomata superficial..... 31
30 Stomata immersed..... 36
31 Capsules immersed or emergent..... 32
31 Capsules exserted..... 34
32 Peristome teeth reflexed when dry; lvs. slender pointed.....*Orthotrichum praemorsum*
32 Peristome teeth mostly erect when dry; lvs. obtuse to broadly acute..... 33
33 Peristome teeth lightly papillose to nearly smooth.....*Orthotrichum rupestre*
33 Peristome teeth very rough, warty.....*Orthotrichum texanum*
34 Capsules strongly ribbed when dry....*Orthotrichum microblepharum*
34 Capsules smooth except when old and empty..... 35
35 Lvs. blunt to broadly obtuse.....*Orthotrichum laevigatum*
35 Lvs. slenderly acute at apex.....*Orthotrichum macounii*
35 Lvs. abruptly acute.....*Orthotrichum macounii* var. *louchothecium*[3]
36 Lvs. blunt and rounded at apex.....*Orthotrichum jamesianum*
36 Lvs. slenderly or broadly acute..... 37
37 Peristome teeth striate throughout; peristome single..... 38
37 Peristome teeth striate above, papillose below; peristome double.....*Orthotrichum alpestre*
37 Peristome teeth papillose throughout; peristome double..... 39
38 Lvs. bistratose above; capsules oblong.....*Orthotrichum hallii*
38 Lvs. unistratose above; capsules subglobose..*Orthotrichum cupulatum*
39 Lvs. reaching 3 mm. in length....*Orthotrichum alpestre* var. *occidentale*
39 Lvs. reaching 4 mm. in length.....*Orthotrichum alpestre* var. *watsoni*
40 Lvs. spirally twisted and contorted; gemmae often present.....*Grimmia torquata*

[3] This variety is intermediate between *O. macounii* and *O. laevigatum* in the shape of the leaf apex. The typical plants of the two species are quite distinct, but there are many forms with no clear lines of distinction between the three taxa given under number 35.

40 Lvs. not spirally twisted; gemmae not present..... 41
41 Leaf margins plane or incurved..... 42
41 One or both margins recurved..... 47
42 Lvs. squarrose from an ovate base; basal leaf cells incrassate and sinuose.....*Grimmia ovalis (G. commutata)*
42 Lvs. not squarrose; basal cells not sinuose..... 43
43 Lvs. concave, not keeled, margins plane, capsules immersed or emergent..... 44
43 Lvs. keeled..... 45
44 Lvs. usually obovate, margins denticulate above, capsules immersed, peristome present, calyptra plicate and covering capsule to middle or below.....*Grimmia wrightii*
44 Lvs. ovate to ovate-lanceolate, margins entire except for the long, spinulose, decurrent hair points; capsules emergent, peristome present, calyptra shorter.....*Grimmia laevigata*
45 Leaf margins incurved; capsules exserted, symmetrical and peristomate..... 46
45 Leaf margins plane; capsules immersed, asymmetrical, without peristome.....*Grimmia anodon*
46 Lvs. 1.5-2.5 mm. long; operculum long-beaked....*Grimmia montana*
46 Lvs. 1-1.5 mm. long; operculum conic.....*Grimmia alpestris*
47 Calyptra covering most of capsule.....*Grimmia calyptrata*
47 Calyptra shorter..... 48
48 Capsules immersed, operculum attached to columella.....*Grimmia apocarpa*
48 Capsules exserted, operculum free..... 49
49 Lvs. 1-1.5 mm. long; basal cells mostly short-rectangular..... 50
49 Lvs. 2 mm. or more long; basal cells elongate..... 51
50 Leaf margins unistratose, basal cells near midrib elongate; seta arcuate.....*Grimmia orbicularis*
50 Leaf margins bistratose; seta arcuate.....*Grimmia pulvinata*
51 Seta not arcuate; alar cells hyaline and with thicker cross walls.....*Grimmia affinis (G. ovalis)*
51 Seta arcuate; alar cells not as above.....*Grimmia trichophylla*
52 Capsules strongly ribbed when dry..... 53
52 Capsules not strongly ribbed or plants sterile..... 56
53 Capsules inclined to horizontal, somewhat asymmetric but not conspicuously so..... 54
53 Capsules strongly asymmetric..... 55
54 Peristome single, the 16 teeth split to base; capsules dark reddish brown.....*Ceratodon purpureus*
54 Peristome double; capsules yellow-brown to brown..... 23
55 Leaf cells not papillose; segments of inner peristome opposite the teeth.....*Funaria hygrometrica*
55 Leaf cells papillose; segments alternate.....*Philonotis fontana*
56 Leaves with a border of differentiated cells..... 57
56 Leaves not bordered..... 63
57 Border of 3-7 rows of thickened and enlarged cells, the marginal row of small cells.....*Merceya latifolia*
57 Border otherwise..... 58
58 Leaf cells usually papillose; capsules inclined and asymmetric, peristome single.....*Desmatodon cernuus*

58 Leaf cells smooth; capsules pendent but symmetric (in *Bryum pallens* somewhat asymmetric), peristome double..... 59
59 Median leaf cells not more than 2:1..... 60
59 Median leaf cells more than 2:1..... 78
60 Leaf margin with teeth in pairs..... 61
60 Leaf margin with teeth single or without teeth..... 62
61 Leaf border well developed, teeth always in pairs.....*Mnium serratum*
61 Leaf border less well developed; teeth in pairs or sometimes single.....*Mnium arizonicum*
62 Inflorescence synoicous.....*Mnium medium*
62 Inflorescence dioicous.....*Mnium affine*
63 Plants almost colorless, silvery white.....*Bryum argenteum*
63 Plants green..... 64
64 Lvs. filiform from a broader base; capsules pear-shaped with a long narrow neck.....*Leptobryum pyriforme*
64 Plants otherwise..... 65
65 Lvs. with hyaline, yellow or orange sheath broader than leaf..... 66
65 Lvs. otherwise..... 68
66 Leaf sheath orange.....*Timmia austriaca*
66 Leaf sheath hyaline or yellow..... 67
67 Leaf cells 6-9 μ.....*Timmia bavarica*
67 Leaf cells 10-15 μ.....*Timmia megapolitana*
68 Leaf cells smooth..... 69
68 Leaf cells not smooth, papillose or rarely with thickened ridges which appear as papillae in cross section..... 89
69 Capsules erect, with a narrow hypophysis..... 70
69 Capsules not erect..... 71
70 Lvs. long acuminate.....*Tayloria serrata*
70 Lvs. short-acuminate or acute..*Tayloria splachnoides* var. *acuminata*
71 Capsules asymmetric..... 72
71 Capsules symmetric but pendent..... 74
72 Capsules strumose, peristome single; leaf margins usually of two layers of cells.....*Oncophorus virens*
72 Capsules not strumose, peristome double, outer teeth shorter than inner; leaf margins one layer..... 73
73 Lvs. entire, blunt at apex, margins revolute.....*Meesia uliginosa*
73 Lvs. serrate, acute, margins plane.....*Meesia triquetra*
74 Median leaf cells elongated, 4:1 or longer..... 75
74 Median leaf cells usually less than 4:1..... 78
75 Dry capsules as broad as long.....*Pohlia wahlenbergii*
75 Dry capsules longer than broad..... 76
76 Plants whitish green with a metallic lustre.....*Pohlia cruda*
76 Plants otherwise..... 77
77 Plants paroicous with a pair of antheridia at base of each perichaetial leaf, commonly fertile; gemmae wanting..*Pohlia nutans*
77 Plants dioicous but usually sterile; gemmae common, yellow to green, elongate and twisted.....*Pohlia annotina* var. *decipiens*
77 Plants dioicous, commonly fruiting; gemmae rare, red, not twisted.....*Pohlia drummondii*
78 Lvs. nearly colorless above, plants silvery.....*Bryum argenteum*
78 Plants green, not silvery in appearance..... 79
79 Lvs. blunt and obtuse at apex.....*Bryum muhlenbeckii*
79 Lvs. acute or acuminate..... 80

80 Cilia of inner peristome rudimentary or wanting..... 81
80 Cilia well developed and usually appendiculate..... 83
81 Inner peristome adherent to outer.....*Bryum pendulum*
81 Inner peristome free from outer..... 82
82 Border of leaf strongly differentiated; capsules somewhat asymmetric.....*Bryum pallens*
82 Border not strongly differentiated; capsules symmetric.....*Bryum inclinatum*
83 Outer peristome teeth light yellow..... 84
83 Outer peristome teeth brown..... 85
84 Border of leaf strongly differentiated; capsules somewhat asymmetric.....*Bryum pallens*
84 Border not strongly differentiated; capsules symmetric.....*Bryum turbinatum*
85 Lvs. with a distinct border, contorted and not imbricate when dry; costa not or little excurrent..... 86
85 Lvs. without a distinct border, imbricate; costa plainly excurrent.. 87
86 Lvs. plainly decurrent, cells with thick pitted walls.....*Bryum pseudotriquetrum*
86 Lvs. not or slightly decurrent, cells with walls thin, not pitted.....*Bryum capillare*
87 Autoicous; plants in dense cushions.....*Bryum pallescens*
87 Dioicous; plants not in dense cushions.....*Bryum caespiticium*
87 Synoicous; plants not in dense cushions..... 88
88 Capsules to 3 mm. long.....*Bryum cuspidatum*
88 Capsules to 5 mm. long.....*Bryum cirratum*
89 Lvs. broad in outline, usually widest above middle, one or both margins recurved..... 90
89 Lvs. usually broadest at base, tapering to apex, margins various.... 98
90 Peristome teeth short, usually not twisted, from a narrow basal membrane..... 91
90 Peristome teeth long and spirally twisted, from a broad basal membrane; lvs. with long awns..... 92
91 Costa excurrent as an awn.....*Desmatodon latifolius*
91 Costa not excurrent.....*Desmatodon latifolius* var. *muticus*
92 Lvs. bistratose.....*Tortula bistratosa*
92 Lvs. not bistratose..... 93
93 Leaf papillae large, hollow at base, compound, with four or more branches.....*Tortula papillosissima*
93 Papillae otherwise..... 94
94 Excurrent costa smooth.....*Tortula aurea*
94 Excurrent costa not smooth..... 95
95 Leaf margins revolute from base to apex..... 96
95 Leaf margins not revolute to apex..... 97
96 Lvs. squarrose-recurved when moist, upper leaf cells 12-16 μ; dioicous; plants not conspicuously glaucous.....*Tortula ruralis*
96 Lvs. not squarrose-recurved when moist, upper leaf cells 16-24 μ; dioicous; plants conspicuously glaucous.....*Tortula obtusissima*
97 Lvs. not squarrose-recurved when moist, awn hyaline; monoicous.....*Tortula princeps*
97 Lvs. squarrose-recurved when moist; awn reddish brown; dioicous.....*Tortula norvegica*

98 Basal leaf cells hyaline and extending up margins to form a V..... 99
98 Basal cells not as above..... 100
99 Lvs. not crisped, tips broken off except in young lvs.....*Tortella fragilis*
99 Lvs. crisped, tips not broken.....*Tortella tortuosa*
100 Lvs. striate with thickened cuticular ridges which appear as papillae in cross section.....*Dicranoweisia crispula*
100 Leaf cells papillose..... 101
101 Papillae at one or both ends of elongated cells.....*Philonotis fontana*
101 Papillae not limited to ends of cells..... 102
102 Papillae large, one on upper and one on lower surface of each cell.....*Aulacomnium*, see 23 above
102 Papillae smaller and more numerous..... 103
103 Leaf margins recurved at least at base..... 104
103 Leaf margins plane; peristome wanting.....see 15 above
103 Leaf margins plane or incurved; peristome present.....*Weisia sweetii*
104 Lvs. minutely serrulate at apex.....*Didymodon recurvirostris*
104 Lvs. entire..... 105
105 Peristome lacking and operculum attached to columella.....*Gymnostomum recurvirostrum*
105 Peristome present..... 106
106 Peristome teeth not twisted.....*Didymodon tophaceus*
106 Peristome teeth strongly twisted..... 107
107 Leaf margins recurved to above middle.....*Barbula vinealis*
107 Leaf margins recurved only at base.....*Barbula cylindrica*
108 Midrib wanting or short and double..... 109
108 Midrib single and well developed..... 116
109 Large aquatic plants with long stems; lvs. keeled, alar cells inflated.....*Fontinalis antipyretica*
109 Plants otherwise..... 110
110 Large plants with squarrose lvs. to 4 mm. long.....*Rhytidiadelphus squarrosus*
110 Plants smaller, lvs. not squarrose..... 111
111 Alar cells hyaline and decurrent..... 112
111 Alar cells not hyaline and decurrent, often small and quadrate.... 113
112 Lvs. complanate, not falcate-secund....*Plagiothecium denticulatum*
112 Lvs. not complanate, typically falcate-secund; outer layer of stem cells large and thin walled.....*Hygrohypnum ochraceum*
113 Aquatic; lvs. broadly ovate.....*Hygrohypnum molle*
113 Not aquatic..... 114
114 Alar cells transversely elongate in several rows.....*Pseudoleskeella tectorum*
114 Alar cells quadrate..... 115
115 Leaf margins revolute.....*Hypnum revolutum*
115 Leaf margins not revolute.....*Hypnum vaucheri*
116 Paraphyllia present and numerous..... 117
116 Paraphyllia wanting or few and inconspicuous..... 124
117 Alar cells inflated and forming distinct auricles..... 118
117 Alar cells not inflated..... 120
118 Lvs. neither plicate nor circinate.....*Cratoneuron filicinum*
118 Lvs. plicate and circinate..... 119
119 Branching irregular; stems with few rhizoids....*Cratoneuron falcatum*

119 Branching pinnate; stems with many rhizoids..*Cratoneuron commutatum*
120 Lvs. undulate, rounded-apiculate at apex.....*Neckera menziesii*
120 Lvs. not undulate, acuminate..... 121
121 Paraphyllia branched.....*Helodium blandowii*
121 Paraphyllia not branched but sometimes toothed..... 122
122 Leaf cells papillose with the papillae on lumen, usually central.....*Lescuraea patens*
122 Leaf cells smooth or with papillae formed by projecting cell ends 123
123 Median leaf cells mostly 12-20 μ long, if longer the walls very thick and short cells intermingled.....*Lescuraea incurvata*
123 Many median cells 30 μ or more long, if shorter the walls not greatly thickened.....*Lescuraea radicosa*
124 Alar cells inflated and forming distinct auricles..... 125
124 Alar cells not inflated to form distinct auricles..... 129
125 Lvs. commonly falcate-secund..... 126
125 Lvs. not falcate-secund..... 127
126 Outer layer of stem cells enlarged and thin walled; lvs. denticulate at apex, midrib usually short and double.....*Hygrohypnum ochraceum*
126 Outer layer of stem cells not differentiated; lvs. entire, midrib always single and strong..*Drepanocladus aduncus* var. *polycarpus*
127 Branches julaceous; lvs. broadly ovate to suborbicular, round-obtuse, without acumination or very shortly cuspidate.....*Scleropodium obtusifolium*
127 Plants otherwise..... 128
128 Stem lvs. broadly ovate, strongly concave, abruptly short-acuminate.....*Brachythecium rivulare*
128 Stem lvs. triangular-ovate, slightly concave, slenderly long-acuminate.....*Brachythecium nelsoni*
129 Stem lvs. plicate..... 130
129 Stems lvs. not plicate..... 133
130 Quadrate alar cells forming a definite group..... 131
130 Quadrate alar cells wanting or not forming a definite group.. 132
131 Stems lvs. ovate to ovate-lanceolate; branch lvs. with midrib not reaching apex; capsules horizontal, asymmetric, cilia well developed.....*Brachythecium leibergii*
131 Stem lvs. elongate-lanceolate; branch lvs. with midrib stout and reaching into apex; capsules erect and cilia rudimentary.....*Homalothecium nevadense*
132 Lvs. strongly falcate-secund except in varieties, narrowly elongate-lanceolate; seta smooth.....*Drepanocladus uncinatus*
132 Lvs. not falcate-secund; stem lvs. triangular-ovate; seta rough.....*Brachythecium lamprochryseum*
133 Aquatic; lvs. entire, 2-2.5 mm. long, median cells 8-12:1, alar cells not differentiated and not decurrent.....*Leptodictyum riparium*
133 Plants without this combination of characters..... 134
134 Median leaf cells 12:1 or more..... 135
134 Median leaf cells 10:1 or less..... 136
135 Branches julaceous; lvs. broadly ovate to oblong-ovate, abruptly narrowed to a short point.....*Scleropodium illecebrum*
135 Branches not julaceous; lvs. ovate-lanceolate, gradually long-acuminate.....*Brachythecium rutabulum*

136 Alar cells forming a conspicuous group, part or all transversely elongate 137
136 Alar cells not forming a conspicuous group or all quadrate 138
137 Small plants with lvs. 1 mm. or less in length ..... *Pseudoleskeella catenulata* var. *filescens*
137 Large plants with lvs. 2-3 mm. long ..... *Antitrichia californica*
138 Lvs. serrate above and serrate or serrulate to base; quadrate alar cells numerous and forming a well defined group 139
138 Lvs. entire or merely serrulate; alar cells not differentiated or few and not forming a well defined group 143
139 Operculum long-rostrate 140
139 Operculum conic 141
140 Plants regularly pinnate to bipinnate ..... *Eurhynchium stokesii*
140 Plants not regularly pinnate ..... *Eurhynchium diversifolium*
141 Capsules erect and cilia rudimentary ..... *Brachythecium utahense*
141 Capsules not erect, cilia well developed 142
142 Median leaf cells 3-6: 1 ..... *Brachythecium collinum*
142 Median leaf cells 6-8: 1 ..... *Brachythecium collinum* var. *idahense*
143 Costa percurrent or excurrent 144
143 Costa not percurrent 145
144 Aquatic or sub-aquatic, not in compact tufts or cushions; lvs. entire or sinuolate, median cells 6: 1 or less ..... *Hygroamblystegium orthocladon*
144 Not aquatic, in deep tufts or cushions: leaf margins serrulate with teeth at leaf base often formed by two adjacent marginal cells; paraphyllia sometimes present ..... *Amblystegium compactum*
145 Lvs. not wide-spreading; marginal cells at base quadrate to transversely elongate ..... *Amblystegium serpens*
145 Lvs. wide-spreading; marginal cells not transversely elongate 146
146 Stem lvs. reaching 1.2 mm. in length ..... *Amblystegium juratzkanum*
146 Stem lvs. reaching 1.6 mm. in length ..... *Leptodictyum trichopodium*

Polytrichaceae

Polytrichadelphus lyallii Mitt. (4) *2654*. Elko Co., Clover Mts., *Watson* 1451 (US).

Polytrichum juniperinum Hedw. (5) *2663*; (7) *2684*.

Fissidentaceae

Fissidens grandifrons Brid. Near Carson City, *Watson* 1378 (US, NY).

Ditrichaceae

Ceratodon purpureus (Hedw.) Brid. (16) *2819*; (17) *2870*; (25) *2943*; (40) *3050*. Churchill Co., Hot Springs Mts., *Watson* 1394 (US, NY).

Distichium capillaceum (Hedw.) B.S.G. (3) *2636*; (5) *2664*; (12) *2761*, *2773*; (17) *2857*. Elko Co., East Humboldt Mts., *Watson* 1395 (US, NY).

Distichium inclinatum (Hedw.) B.S.G. (24) *2940*. The Charleston Mts. are between the 36th and 37th parallels; this station is farther south than any other reported for the species. It was reported from the Bear River Canyon, Uintah Mts., Utah, between the 40th and 41st parallels, *Watson* 1396, specimen not seen. It was collected by Bolander at Soda Springs,

Upper Tuolumne, Yosemite National Park, Calif. (Lesquereux, 1868), which is just south of the 38th parallel, specimen not seen.

Dicranaceae

Dicranoweisia crispula (Hedw.) Lindb. (12) *2747* on wood, *2748*, *2751*; (14) *2795* on wood, *2796*; (16) *2817*; (17) *2875*, *2886*, *2887*, *2897*; (25) *2942*; (40) *3052*, *3055*; (42) *3121*.

Oncophorus virens (Hedw.) Brid. (7) *2697*.

Encalyptaceae

Encalypta vulgaris Hedw. Elko Co., Ruby Mts., Secret Valley, *Watson* 1397 (US).

Encalypta vulgaris var. apiculata Wahlenb. (33) *3013*.

Encalypta vulgaris var. mutica Brid. (11) *2732*; (12) *2757*; (13) *2782*; (15) *2800*; (17) *2879*; (18) *2899*; (24) *2931*; (25) *2941*; (26) *2947*; (27) *2952*; (28) *2964*; (29) *2971*; (31) *2890*; (33) *3000*; (34) *3018*; (37) *3027*; (40) *3047*. Pershing Co., Trinity Mts., *Watson* 1397 (NY).

Encalypta rhabdocarpa Schwaegr. Elko Co., East Humbolt Mts., *Watson* 1399 (US).

Pottiaceae

Barbula cylindrica (Tayl.) Schimp. Pershing Co., West Humboldt Mts., *Watson* 1388 (US, NY), reported as *Didymodon cylindricus* Nees & Hornsch.

Barbula vinealis Brid. (2) *2611*.

Crossidium griseum (Jur.) Jur. (21) *2920*, sterile and not common.

Desmatodon cernuus (Hüben.) B.S.G. Elko Co., Ruby Valley, *Watson* 1386 (US).

Desmatodon latifolius (Hedw.) Brid. (4) *2660*; (5) *2669*; (16) *2832*.

Desmatodon latifolius var. muticus Brid. (7) *2704*. Elko Co., East Humboldt Mts., *Watson* 1384 (NY).

Didymodon recurvirostris (Hedw.) Jenn. (3) *2647*; (5) *2668*; (7) *2691*; (16) *2838*. Elko Co., East Humboldt Mts., Fremont's Pass, *Watson* 1387 (US).

Didymodon tophaceus (Brid.) Jur. (30) *2974*.

Gymnostomum aeruginosum Smith. (3) *2639*.

Gymnostomum recurvirostrum Hedw. (5) *2677*.

Merceya latifolia Kindb. (30) *2973*, sterile but very abundant on stones at edge of Cold Creek.

Pottia heimii (Hedw.) Fürnr. (11) *2745*. Pershing Co., West Humboldt Mts., *Watson* 1382 (US, NY).

Pottia nevadensis Card. & Thér. Near Carson City, *Watson* 1381 (US), reported as *Pottia truncata* var. *subcylindrica*. Ormsby Co., King's Canon, *Baker* 959 (NY).

Pterigoneuron ovatum (Hedw.) Dix. Near Carson City, *Watson* 1379 (US, NY), reported as *Pottia subsessilis* Schw. Eureka Co., about 10 mi. west of Eureka, June 6, 1939, *T.C. & E. M. Frye 2896* (WTU).

Tortella fragilis (Hook. & Wils.) Limpr. (15) *2801*.

Tortella tortuosa (Turn.) Limpr. (24) *2934*; (28) *2959*.

Tortula aurea Bartr. (20) *2917*.

Tortula bistratosa Flowers. (11) *2739*; (37) *3029*. Eureka Co., near Eureka, June 5, 1939, *Frye 2894* (WTU).

Tortula norvegica (Web. & Mohr) Wahlenb. (28) *2960*.

TORTULA OBTUSISSIMA (C. M.) Mitt. Humboldt Co., near Winnemucca, July 1901, *Griffiths & Morris* 44 (US, NY).

TORTULA PAPILLOSISSIMA (Coppey) Broth. (2) 2614, 2623; (33) 3001, 3008; (34) 3017; (37) 3030. This species was first found in America by Flowers (1953).

TORTULA PRINCEPS DeNot. (37) 3034. Near Carson City, *Watson* 1391 (US, NY), reported as *Barbula brevipes* Lesq.; near Carson City, *Watson* 1393 (US), reported as *Barbula muelleri* Bruch.

TORTULA RURALIS (Hedw.) Smith. Very common and widespread, but not found in Nye, Churchill, Lyon and Washoe Counties. Ormsby Co., King's Canon, *Baker* 1120 (NY).

WEISIA SWEETII Bartr. Clark Co., Virgin Mts., Yant Pit Canyon, *Sweet* 78 (Bartram, 1945), not seen.

GRIMMIACEAE

GRIMMIA AFFINIS Hornsch. ["*G. ovalis* (Hedw.) Lindb." of *Moss Fl. N. Am.*] (20) 2918, 2919. Pershing Co., West Humboldt Mts., *Watson* 1413 (US); Washoe Co., Truckee Mts., *Watson* 1413 (NY). The nomenclature of this species was discussed by Sayre (1951).

GRIMMIA ALPESTRIS Nees. Very abundant with 21 collections made, from all areas of high elevation; with the exception of Charleston Mts., (28) 2965, it was not found in Lincoln or Clark Counties.

GRIMMIA ANODON B.S.G. A large number of collections was made, from all areas except Humboldt and Elko Counties and around Lake Tahoe. It was the only moss collected in Lyon Co. (38) 3035. Elko Co., Ruby Mts., Secret Valley, *Watson* 1410 (US, NY).

GRIMMIA APOCARPA Hedw. (1) 2610; (4) 2655; (17) 2867; (28) 2966.

GRIMMIA APOCARPA var. CONFERTA (Funck) Spreng. (17) 2889.

GRIMMIA APOCARPA var. CONFERTA f. OBTUSIFOLIA (B.S.G.) Moenk. (8) 2709.

GRIMMIA APOCARPA var. GRACILIS (Schleich.) Web. & Mohr (19) 2913.

GRIMMIA CALYPTRATA Hook. (2) 2617, 2625; (11) 2740; (14) 2794; (16) 2816; (17) 2878; (19) 2908; (31) 2983; (32) 2996; (33) 3007; (34) 3019; (35) 3020; (37) 3025, 3032. Near Carson City, *Watson* 1414 (US). The most abundant moss in the state but not as widespread as some other species.

GRIMMIA LAEVIGATA (Brid.) Brid. (23) 2927. Elko Co., Ruby Mts., Secret Valley, *Watson* 1415 (US).

GRIMMIA MONTANA B.S.G. Pah Ute Mts., *Watson* 1416 (US).

GRIMMIA ORBICULARIS Bruch. (20) 2916.

GRIMMIA OVALIS (Hedw.) Lindb. ["*G. commutata* Hüben." of *Moss Fl. N. Am.*] (1) 2605; (19) 2910; (42) 3102.

GRIMMIA PULVINATA (Hedw.) Smith. (19) 2914. Churchill Co., Hot Springs Mts., *Watson* 1411 (US).

GRIMMIA TORQUATA Hornsch. (42) 3104.

GRIMMIA TRICHOPHYLLA Grev. (40) 3067; (42) 3120.

GRIMMIA WRIGHTII Aust. (21) 2921, 2924; (23) 2928.

FUNARIACEAE

FUNARIA HYGROMETRICA Hedw. (3) 2643; (8) 2708; (11) 2738; (42) 3112. Elko Co., Ruby Valley, *Watson* 1420 (US). Clark Co., near Las Vegas, May 8, 1905, *L. N. Goodding* (NY).

FUNARIA HYGROMETRICA var. CONVOLUTA Hampe. (40) 3054.

PHYSCOMITRIUM CALIFORNICUM Britt. (42) 3107, at edge of irrigation ditch.

PHYSCOMITRIUM MEGALOCARPUM Kindb. Nevada, *Palmer* (US), not seen.

PHYSCOMITRIUM PYGMAEUM James. Ormsby Co., King's Canon, *Baker* 908 (US).

SPLACHNACEAE

TAYLORIA SERRATA (Hedw.) B.S.G. (3) 2633, sterile.

TAYLORIA SPLACHNOIDES var. ACUMINATA (Schleich.) Hüben. Pershing Co., Unionville, *Watson* 1417 (US).

ORTHOTRICHACEAE

AMPHIDIUM LAPPONICUM (Hedw.) Schimp. (3) 2635, fruiting plants very abundant on a ledge near waterfall.

ORTHOTRICHUM ALPESTRE Hornsch. (33) 2999; (42) 3114.

ORTHOTRICHUM ALPESTRE var. OCCIDENTALE (James) Grout. (13) 2874; (16) 2815, 2841; (17) 2876; (33) 3015; (35) 3022. Pah Ute Mts., *Watson* 1407 (US).

ORTHOTRICHUM ALPESTRE var. WATSONI (James) Grout. (2) 2619; (33) 2997. Pershing Co., West Humboldt Mts., *Watson* 1402 (US), sterile but with Grout's annotation.

ORTHOTRICHUM CUPULATUM (Hoffm.) Brid. (33) 3005, 3016.

ORTHOTRICHUM HALLII Sull. & Lesq. (17) 2881; (27) 2954; (33) 3006.

ORTHOTRICHUM JAMESIANUM Sull. (11) 2733; (12) 2758; (17) 2877; (18) 2900; (24) 2932. Elko Co., East Humboldt Mts., *Watson* 1401, the type (US).

ORTHOTRICHUM LAEVIGATUM Zett. (3) 2628; (39) 3036; (40) 3044; (42) 3113. Ormsby Co., King's Canon, *Baker*, June 21, 1902 (NY).

ORTHOTRICHUM MACOUNII Aust. (2) 2621; (11) 2734. Pah Ute Mts., *Watson* 1414 (US), reported as *O. laevigatum*, but *O. macounii* was not described until 1879.

ORTHOTRICHUM MACOUNII var. LONCHOTHECIUM (C. M. & Kindb.) Grout. (40) 3065.

ORTHOTRICHUM MICROBLEPHARUM Schimp. (40) 3064.

ORTHOTRICHUM PRAEMORSUM Vent. (42) 3115.

ORTHOTRICHUM RUPESTRE Schleich. (40) 3066.

ORTHOTRICHUM TEXANUM Sull. (39) 3037; (42) 3116. Clear Creek Canyon near Carson City, *Watson* 1403 (US), reported as *O. anomalum*, but the stomata are superficial and the peristome teeth strongly papillose in the specimen examined. Pershing Co., West Humboldt Mts., *Watson* 1400 (US), reported as *O. sturmii*.

TIMMIACEAE

TIMMIA AUSTRIACA Hedw. (3) 2631.

TIMMIA BAVARICA Hessl. (17) 2882.

TIMMIA MEGAPOLITANA Hedw. (12) 2755; (24) 2936; (28) 2962. Pershing Co., West Humboldt Mts., *Watson* 1448 (NY).

AULACOMNIACEAE

AULACOMNIUM ANDROGYNUM Schwaegr. (40) 3051. Elko Co., East Humboldt Mts., *Watson* 1443 (US).

AULACOMNIUM PALUSTRE (Web. & Mohr) Schwaegr. (16) 2820; (17) 2854; (41) 3077.

BARTRAMIACEAE

PHILONOTIS FONTANA (Hedw.) Brid. (5) 2673; (6) 2681; (7) 2688; (8) 2707; (9) 2716; (14) 2790; (16) 2818; (17) 2864; (31) 2994; (36)

3024; (41) 3081. In a mountain meadow on Baker Creek in the Snake Mts. this fruiting moss covered a very large area. Elko Co., East Humboldt Mts., *Watson* 1446 (US), reported as *P. calcarea* and included in the envelope with *Aulacomnium androgynum*, 1443.

MEESIACEAE

MEESIA TRIQUETRA (Hook. & Tayl.) Ängstr. (41) 3079.

MEESIA ULIGINOSA Hedw. (41) 3078. Elko Co., Clover Mts., *Watson* 1444 (US).

BRYACEAE

BRYUM ARGENTEUM Hedw. (10) *2729*; (13) *2783*; (18) *2904a*; (25) *2943* with *Ceratodon purpureus;* (33) *3011*.

BRYUM CAESPITICIUM Hedw. (17) *2885*; (33) *3014*.

BRYUM CAPILLARE Hedw. (4) *2656*; (5) *2672*; (12) *2760*, *2764*; (18) *2904b*; (42) *3118*.

BRYUM CIRRATUM Hoppe & Hornsch. (5) *2671b*; (39) *3040*.

BRYUM CUSPIDATUM (B.S.G.) Schimp. (3) *2638*, *2646*; (7) *2689*; (8) *2714*; (9) *2720*; (12) *2753*, *2774*; (14) *2788*; (16) *2807*; (17) *2874*; (31) *2992a*; (33) *3012*. Douglas Co., Kingsbury Rd., June 29, 1939, *P. Train* 3159 (NY).

BRYUM INCLINATUM (Web. & Mohr) Sturm. (3) *2629*; (4) *2659*.

BRYUM MUHLENBECKII B.S.G. (1) *2608*; (2) *2624*; (6) *2682*; (10) *2724*.

BRYUM PALLENS (Web. & Mohr) Brid. (5) *2671a*; (41) *3076*.

BRYUM PALLESCENS Schleich. (5) *2670*; (10) *2725*; (16) *2834*; (41) *3075*.

BRYUM PENDULUM (Hornsch.) Schimp. Pershing Co., Unionville, *Watson* 1426 (US). Ormsby Co., King's Canon, *Baker*, June 2, 1902, Holz. *Musc. Acro. Bor. Am.* 171 (US).

BRYUM PSEUDOTRIQUETRUM (Hedw.) Schwaegr. (2) *2612*; (7) *2687*, *2701*; (8) *2713*; (11) *2743*; (18) *2898* with *Amblystegium compactum*.

BRYUM TURBINATUM (Hedw.) Schwaegr. (11) *2735*, *2744*; (14) *2792*; (19) *2911*; (25) *2944*; (41) *3080*.

LEPTOBRYUM PYRIFORME (Hedw.) Schimp. (9) *2717*; (12) *2752*; (17) *2856*; (31) *2991*; (41) *3074*; (42) *3108*. Elko Co., Ruby Valley, *Watson* 1422 (US).

POHLIA ANNOTINA var. DECIPIENS Loeske. (41) *3071*.

POHLIA CRUDA (Hedw.) Lindb. (3) *2650*; (9) *2721*; (16) *2812*, *2833*. Elko Co., Clover Mts., *Watson* 1423 (US).

POHLIA DRUMMONDII (C.M.) Andrews. Washoe Co., Marlette Lake, *Baker* 1904 (NY).

POHLIA NUTANS (Hedw.) Lindb. (16) *2824*; (17) *2865*; (41) *3073*.

POHLIA WAHLENBERGII (Web. & Mohr) Andrews. (3) *2641* with *Bryum cuspidatum*. Elko Co., Ruby Mts., Secret Valley, *Watson* 1425 (US).

MNIUM AFFINE Bland. Elko Co., East Humboldt Mts., Fremont's Pass, *Watson* 1440 (US).

MNIUM ARIZONICUM Amann. (17) *2891*; (24) *2935*.

MNIUM MEDIUM B.S.G. (16) *2826*; (17) *2872*.

MNIUM SERRATUM Brid. (3) *2642*; (12) *2756*, *2776*; (16) *2813*; (17) *2869*, *2873*; (31) *2993*; (40) *3057*.

HYPNACEAE

AMBLYSTEGIUM AMERICANUM Grout. (30) *2980*.

AMBLYSTEGIUM COMPACTUM (C. M.) Aust. (18) 2898 with *Brynm pseudotriquetrum;* (30) 2979.

AMBLYSTEGIUM JURATZKANUM Schimp. (3) 2640, 2649; (10) 2726; (12) 2777; (14) 2791; (16) 2809; (30) 2992b; (41) 3072.

AMBLYSTEGIUM SERPENS (Hedw.) B.S.G. (8) 2712; (9) 2722; (12) 2781. Ormsby Co., King's Canon, *Baker* 960 (NY). Douglas Co., Glenbrook, *Baker* 1346 (NY).

BRACHYTHECIUM COLLINUM (Schleich.) B.S.G. (1) 2606; (3) 2630; (5) 2676; (7) 2685; (10) 2727; (12) 2750, 2766; (15) 2803; (16) 2828a, 2837, 2843; (17) 2871, 2880, 2884, 2893; (25) 2945; (27) 2957; (28) 2967; (33) 3062; (40) 3049, 3058.

BRACHYTHECIUM COLLINUM var. IDAHENSE (Ren. & Card.) Grout. (12) 2779; (16) 2828b; (42) 3122.

BRACHYTHECIUM LAMPROCHRYSEUM C. M. & Kindb. (7) 2696; (11) 2737, 2746; (12) 2778; (14) 2797; (16) 2806; (31) 2986.

BRACHYTHECIUM LEIBERGII Grout (8) 2711.

BRACHYTHECIUM NELSONI Grout (3) 2648; (14) 2793.

BRACHYTHECIUM RIVULARE B.S.G. (17) 2860 contains an aberrant form of this species; all the leaves have inflated alar cells and the leaves of many branches have the typical *B. rivulare* apex, while the stems and some branches bear leaves which strongly resemble those of *B. lamprochryseum.* Elko Co., East Humboldt Mts., Fremont's Pass, *Watson* 1458 (US) is typical of the species.

BRACHYTHECIUM RUTABULUM (Hedw.) B.S.G. (9) 2723; (30) 2981; (40) 3061. Pershing Co., West Humboldt Mts., *Watson* 1456 (US).

BRACHYTHECIUM UTAHENSE James. (17) 2892.

CRATONEURON COMMUTATUM (Hedw.) Roth. (3) 2637; (7) 2699, 2703.

CRATONEURON FALCATUM (Brid.) Roth. (5) 2665, 2678.

CRATONEURON FILICINUM (Hedw.) Roth. (5) 2675, 2679; (11) 2736; (12) 2780; (17) 2861; (24) 2939; (30) 2975, 2976.

DREPANOCLADUS ADUNCUS var. POLYCARPUS (Bland.) Warnst. (41) 3069. Virginia Mts., *Watson* 1477 (NY).

DREPANOCLADUS UNCINATUS (Hedw.) Warnst. (16) 2829; (17) 2862; (41) 3070.

EURHYNCHIUM DIVERSIFOLIUM (Schleich.) B.S.G. (3) 2632; (4) 2657; (7) 2698.

EURHYNCHIUM STOKESII (Turn.) B.S.G. (40) 3059.

HOMALOTHECIUM NEVADENSE (Lesq.) Ren. & Card. (2) 2613; (37) 3031; (39) 3039; (40) 3046, 3062; (42) 3105. Pershing Co., West Humboldt Mts., *Watson* 1464 (US, NY).

HYGROAMBLYSTEGIUM ORTHOCLADON (P. Beauv.) Grout. Elko Co., Thousand Springs Valley, *Watson* 1468 (US).

HYGROHYPNUM OCHRACEUM (Turn.) Loeske. (8) 2710.

HYGROHYPNUM MOLLE (Schimp.) Loeske (16) 2810, 2845.

HYPNUM REVOLUTUM (Mitt.) Lindb. (3) 2626; (5) 2666; (16) 2850; (17) 2883, 2896; (18) 2902; (27) 2956; (28) 2969; (42) 3125.

HYPNUM REVOLUTUM var. MOLENDOANUM (Schimp.) Lindb. (24) 2930.

HYPNUM VAUCHERI Lesq. (12) 2762; (33) 3004.

LEPTODICTYUM RIPARIUM (Hedw.) Warnst. Elko Co., Thousand Springs Valley, *Watson* 1469 (NY).

LEPTODICTYUM TRICHOPODIUM (Schultz) Warnst. (12) 2754; (30) 2978, an aberrant form with the basal cells of the leaves with thick walls.

PLAGIOTHECIUM DENTICULATUM (Hedw.) B.S.G. (16) 2827.

RHYTIDIADELPHUS SQUARROSUS (Hedw.) Warnst. (7) *2700*, *2702*.

SCLEROPODIUM ILLECEBRUM (Hedw.) B.S.G. (40) *3060*.

SCLEROPODIUM OBTUSIFOLIUM (Hook.) Kindb. Elko Co., Ruby Valley, *Watson* 1472 (US).

LESKEACEAE

HELODIUM BLANDOWII (Web. & Mohr) Warnst. (41) *3068*.

LESCURAEA INCURVATA (Hedw.) Lawton. (3) *2634*.

LESCURAEA PATENS (Lindb.) Arn. & Jens. (42) *3123*.

LESCURAEA RADICOSA (Mitt.) Moenk. (16) *2814*; (42) *3101*.

PSEUDOLESKEELLA CATENULATA var. FILESCENS (Best) Lawton. (17) *2895*.

PSEUDOLESKEELLA TECTORUM (A. Br.) Kindb. (12) *2763*; (15) *2802*; (17) *2888*; (19) *2912*; (24) *2938*; (26) *2948*; (27) *2951*; (29) *2970*; (31) *2987*.

PSEUDOLESKEELLA TECTORUM var. FLAGELLIFERA (Best) Lawton. (33) *3010*.

NECKERACEAE

NECKERA MENZIESII Hook. (42) *3106*.

CRYPHEACEAE

ANTITRICHIA CALIFORNICA Sull. (42) *3100*.

FONTINALACEAE

FONTINALIS ANTIPYRETICA Hedw. Elko Co., Ruby Valley, *Watson* 1452 (US, NY).

LITERATURE CITED

ANDREWS, A. L. 1935. Bryaceae. *In* A. J. Grout, Moss Flora of North America North of Mexico 2: 207. Newfane, Vt.

BARTRAM, E. B. 1945. A new *Weisia* and a new *Tortula* from southwestern United States. THE BRYOLOGIST 48: 90-92.

CARDOT, J. & I. THÉRIOT. 1904. New or unrecorded mosses of North America. Bot. Gaz. 37: *363-382*.

CLARK, LOIS. 1957. Hepaticae collected in Nevada by Elva Lawton in 1955. THE BRYOLOGIST 60: *32-35*.

CRUM, H. & L. E. ANDERSON. 1955. Taxonomic studies in the Funariaceae. THE BRYOLOGIST 58: 1-15.

FLOWERS, S. 1951. A new species of *Tortula* from Utah and Arizona. THE BRYOLOGIST 54: *278-282*.

———. 1953. *Tortula papillosissima*, new to North America. THE BRYOLOGIST 56: 160-164.

GROUT, A. J. 1940. List of mosses of North America north of Mexico. THE BRYOLOGIST 43: 117-131.

JAMES, T. P. 1871. Musci. *In* S. Watson, Botany. United States Geological Exploration of the Fortieth Parallel. 5: 398-411. Washington, D.C.

LAWTON, ELVA. 1957. A revision of the genus *Lescuraea* in Europe and North America. Bull. Torrey Bot. Club 84: 281-307, 337-355.

LESQUEREUX, L. 1868. A catalogue of the Pacific Coast mosses. Calif. Acad. Sci. Mem. 1: 1-38.

SAYRE, GENEVA. 1951. The identity of *Grimmia ovalis* and *Grimmia commutata*. THE BRYOLOGIST 54: 91-94.

THE GENUS PARALEUCOBRYUM

CLARA BARNES[1]

The genus and the species of *Paraleucobryum* are incompletely described, and the species are not clearly separated. This is an attempt to clarify this small group.

PARALEUCOBRYUM Loeske, Hedwigia 47: 171. 1908.

Plants yellow to yellowish-green, to 7.5 cm., usually with several branches. Stems in cross-section without central strand. Larger leaves straight to falcate-secund, sometimes crispate, lanceolate with somewhat sheathing base, often canaliculate, commonly 3-8 mm. long or occasionally longer, entire to serrate ⅔ down. Costa[2] ⅕-9/10 the leaf width in broader basal region, excurrent, smooth to dorsally ridged, consisting mostly of 3 layers of cells; in cross-section ventral surface cells hyaline, dorsal surface cells hyaline to alternating with green cells, central cells green in a continuous layer. Alar cells mostly differentiated, laminal cells somewhat porose. Plants unisexual (so described; we saw no male inflorescence). Setae solitary, about 1 cm. long, smooth, twisted to right; capsules erect, straight; urn cylindric; teeth 16, divided into two prongs, vertically to diagonally striate; basal membrane wanting.

KEY TO SPECIES

Central cells in cross-section of leaf rounded; green cells present in most of dorsal surface; leaf margin serrate ¼ or more down; dorsal surface of costa more or less ridged.....*P. longifolium.*
Central cells in cross-section of leaf diamond-shaped to square, with one angle dorsal; green surface cells wanting throughout; leaf margin entire or merely with 1-4 serrations at tip; dorsal surface of costa smooth..*P. enerve.*

PARALEUCOBRYUM LONGIFOLIUM (Hedw.) Loeske, Hedwigia 47: 171. 1908. *Dicranum longifolium* Hedw., Sp. Musc. 130. 1801; *Dicranum serratum* Kindb., Eur. & N. Am. Bryin. 190. 1897; *Campylopus canadensis* Kindb., Rev. Bryol. 32: 35. 1905; *Paraleucobryum sauteri* (Schimp.) Loeske, Hedwigia 47: 171. 1908. Plants yellowish-green, to 3 cm. high, sometimes with several branches. Stem in cross-section without central strand; interior cells large, rounded, with fairly thin walls; cortex of 1-3 layers of smaller darker cells; epidermal cells square to rectangular,

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[2] The word costa throughout this paper indicates that portion of the leaf which is more than one cell thick.

up to twice as wide as thick with thicker walls which sometimes protrude as a ridge where cells meet. Larger leaves mostly falcate-secund to crispate, narrowly lanceolate with slightly sheathing base, somewhat canaliculate, 3-8 or more mm. long, margin serrate for ⅓-⅔ from tip. Costa excurrent, ⅕-¾ wide at broader basal region, ridged dorsally from a short distance above base, ridges formed by green surface cells; in cross-section costa made up of 3 layers of cells, ventral surface cells hyaline, dorsal surface cells mostly hyaline with some green cells among them, central cells a continuous layer of mostly rounded green cells. Alar cells sometimes differentiated, 1-2 times as long as wide, somewhat inflated, dark or a few hyaline, sometimes extending to costa; laminal cells at ⅓ from base, 1-7 times as long as wide, smooth, rectangular, or occasional ones dove-tailing, somewhat porose, sometimes wanting, few hyaline. Plants unisexual. Perichaetial leaves abruptly subulate from sheathing base. Setae solitary, about 1 cm. long, smooth, twisted to right; capsule erect, straight; urn about 1 mm. wide and 2 mm. long; teeth 16, about 224 μ long, divided into two prongs for ½-¾ the length, smooth to vertically to diagonally striate to near base, papillae few to numerous; basal membrane wanting. Spores about 23 μ in diameter, rough. Plants in compact tufts on rotting logs, living trees, rocks or soil.

PARALEUCOBRYUM ENERVE (Thed.) Loeske, Hedwigia 47: 171. 1908. *Dicranum enerve* Thed. *in* Hartm., Skand. Fl. (Ed. 5). 393. 1849; *Dicranum albicans* BSG, Bryol. Eur. pl. 73. 1850; *Campylopus hallii* Lesq. *in* Porter & Coulter, Fl. Colorado. 155. 1874. Plants yellowish-green, to 7.5 cm., usually with several short branches. Stem in cross-section without a central strand, but central cells somewhat smaller; intermediate cells large, rounded; cortex of 1-4 layers of smaller, darker cells; irregular in form; epidermal cells same as other cortical ones. Larger leaves straight to somewhat falcate-secund, lanceolate, usually with sheathing base, canaliculate, 3-6 mm. long, 500-600 μ wide, margin entire or sometimes with 1-4 serrations at tip. Costa excurrent, smooth, 9/10 or more of width of leaf base; in cross-section consisting of 3 layers of cells; cells of both surfaces large, hyaline; central cells a continuous layer, smaller, green, diamond-shaped to square, with one angle dorsal. Alar cells differentiated to costa, 1-2 times as long as wide, mostly inflated, with darker walls or a few hyaline; laminal cells at ⅓ from base rectangular to dove-tailed, smooth, few hyaline, 7-10 times as long as wide, somewhat porose. Plants unisexual. Perichaetial leaves abruptly subulate from sheathing base. Setae solitary, about 1 cm. long, smooth, twisted to right. Capsule erect,

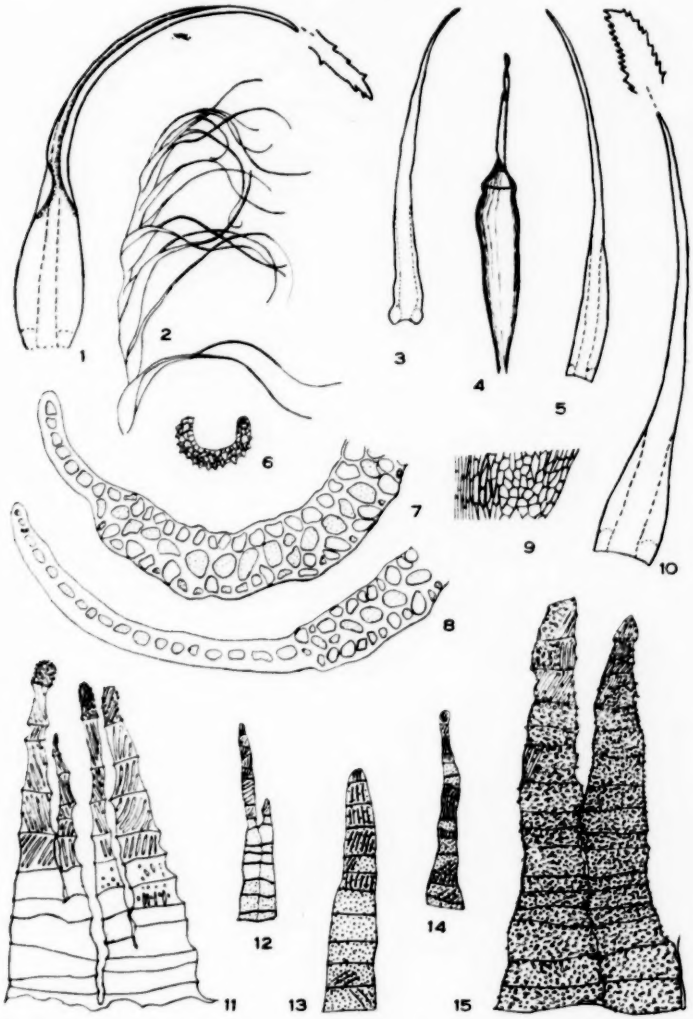

FIG. 1-15. *Paraleucobryum longifolium*. 1. Leaf, × 13; apex, × 57. 2. Part of plant, × 6. 3. Leaf, × 6. 4. Capsule, × 12. 5. Leaf, × 12. 6. Cross-section of leaf near apex, × 61. 7, 8. Cross-sections of leaves shortly above alar cells, × 238. 9. Alar cells, × 61. 10. Leaf, × 12; apex, × 57. 11-15. Variations in peristome teeth (11, × 238; 12, × 149; 13, × 238; 14, × 149; 15, × 272).

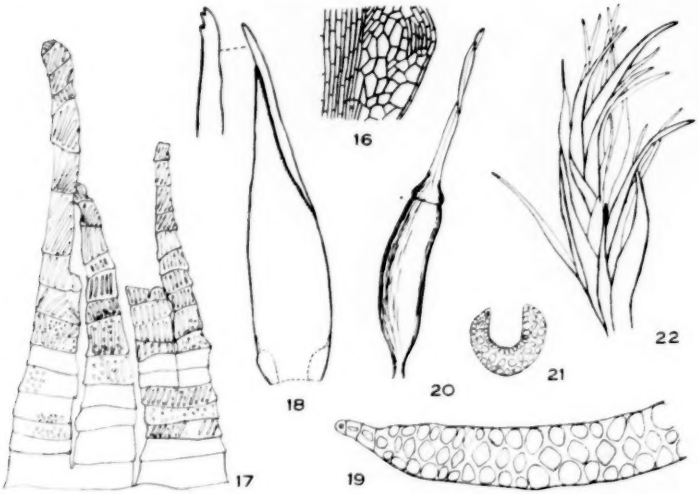

FIG. 16-22. *Paralecuobryum enerve*. 16. Alar cells, × 61. 17. Peristome teeth, × 238. 18. Leaf, × 13; apex × 61. 19. Cross-section of leaf shortly above alar cells, × 238. 20. Capsule, × 13. 21. Cross-section of leaf near apex, × 100. 22. Part of plant, × 6.

straight; urn cylindric, about 1 mm. wide and 2 mm. long, somewhat wrinkled when dry, its surface cells smooth, mostly rectangular to square; stomata superficial, near base; lid about 375 μ in diameter and 1.5-2 mm. long; teeth 16, about 285 μ long, divided into two prongs about ⅓-¾ their length, mostly striate, with some papillae; striae vertical to diagonal; basal membrane wanting. Spores about 15 μ in diameter, rough. Plants in compact tufts on rocks and soil.

There seems to be no consistent difference between *P. longifolium* and *P. sauteri*. All the characteristics of the two intergrade, so that there is no definite line of demarcation. No one difference is common to all the plants. Characteristics which are most commonly used to separate *P. longifolium* and *P. sauteri* are the width of the costa and the length of the leaf, but these overlap completely. *P. longifolium* has a costa from ⅕-¾ the width of the leaf and a leaf length of 3-8 mm.; and *P. sauteri* has a costa of ⅕-½ the width and a leaf length of 3-7 mm. Another leaf characteristic which is sometimes used is that of the serrations, but here again the number and distances covered by the serrations grade together without a distinct break. The leaf characterstics

which vary as to type and combination cannot be depended upon as a basis for retaining *P. sauteri* as a species. Plants referred to *P. sauteri* usually have many papillae on the peristome teeth with few striations; and those referred to *P. longifolium* tend to have more striations with fewer papillae; but this is not correlated with the variation in the leaf characters. If these minor differences were used to separate the plants even as forms, one would have to distinguish many. For these reasons I consider *P. longifolium* a variable species with *P. sauteri* falling within it.

BRACHYTHECIUM HYLOTAPETUM, N. SP.

BETTY WILSON HIGINBOTHAM and N. HIGINBOTHAM[1]

Brachythecium hylotapetum, n. sp.[2] (From the Greek, meaning forest tapestry or carpet.) Gametophyte usually robust, very glossy and bright grass green to pale yellowish green. Stems usually irregularly branched, sometimes subpinnately or rarely pinnately branched, or sometimes unbranched. Stems long, to 1 dm. Stem leaf disposition ranging from loose and widely spreading to crowded and nearly erect. Plants commonly become distinctly complanate in drying, but those with crowded erect leaves may not. The apex of stems and branches may be blunt (in the squarrose-leaved complanate form) or tapered (in the erect-leaved form), although the apical buds of stems are usually large and bluntish because of the large outer bud leaves which are not graduated in size.

Fruiting plants are difficult to find. Sporophytes are formed in the very late fall and apparently mature in the winter under snow. Gametophyte growth appears to be stimulated in the late fall also, when the growing ends of stems and branches become ascending or more or less erect. When seen in midsummer (in northern Idaho and northeastern Washington) on the relatively dry forest floor, the plants are prostrate with the older parts brown

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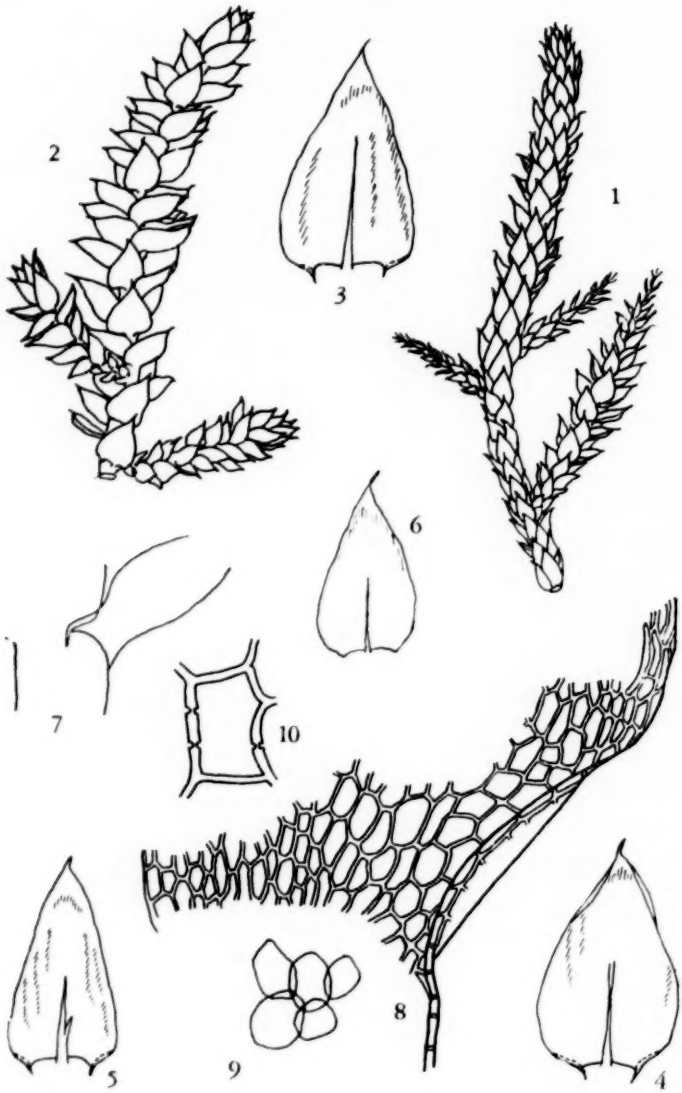
[2] Plantae dioicae, plerumque robustae, nitidae, siccae generaliter complanatae, apicibus caulum foliis confertis. Folia caulina 2⅓ × 1½ usque ad 3⅔ × 2 mm., sicca squarrosa vel ± recta, madida ad apicem valde concava, plerumque recurvo-mucronata, decurrentia, marginibus reflexis prope basem, cellulis alaribus plus minus inflatis, cellulis mediis 10:1—25:1 (plerumque ca. 15:1); costa singula vel furcata. Folia ramulina cellulis alaribus quadratis vel breviter oblongis. Seta ubique papillata, papillis humilibus. Cilia 2-4, papillata, appendiculis longis et angustis. Operculum alte conico-mammillatum.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and often entwined in litter. Occasionally the plants are in solid mats. Rhizoids are often few and inconspicuous. There is a weakly defined central strand. It appears that whether a stem apex is blunt or attenuate may be a condition or stage of growth; spring collections seem to show more of the attenuate form (*fig.* 1), autumn and summer collections more of the blunt form (*fig.* 2).

STEM LEAVES. Moist leaves are strongly concave in the upper half of the leaf and in the upper part of the stem; lower leaves may be less strongly concave or nearly flat; leaves when dry may not appear concave. The concave upper region usually produces a typical rugose appearance in the leaf below the apex when it is viewed under a coverslip; sometimes the leaf may be longitudinally plicate. The apex of stem leaves is usually abruptly apiculate and twisted, rarely acuminate; when seen on the moist stem the apex is more or less recurved. In size, stem leaves range from 2⅓ × 1½ mm. to 3⅔ × 2 mm. The leaf apex is serrate, only occasionally serrulate or very rarely nearly entire. The leaf margin below the apex is serrate or serrulate to entire. Alar cells are strongly enlarged (*fig.* 8), sometimes inflated (*fig.* 9), occasionally subrectangular. The basal tier of cells is conspicuously short and broad with more or less porose walls (*fig.* 8, 10). Both alar cells and basal cells are usually hyaline, the alar cells very rarely brownish. The alar region below the broadest part of the leaf is consistently reflexed in moist stem leaves (*fig.* 7), a feature less easily seen in branch leaves. Stem leaves are decurrent.

Median cells are prosenchymatous with long-tapered ends and a size range from 10:1 to 25:1, commonly about 15:1. Apical leaf cells are sometimes noticeably shorter.

The costa of stem leaves has a dark broad base. It may be single and reach two-thirds the length of the leaf (*fig.* 3), or short

FIG. 1-10. *Brachythecium hylotapetum*, all figures from the type specimen except fig. 2, 4. 1. Terminal portion of stem (male), collected in May; moist, × 2½. 2. Terminal portion of stem (male) showing blunt branches from *Hig.* 97 collected in July; moist, × 2½. 3. Stem leaf from lower part of same stem as fig. 1, moist and under coverslip, dotted lines show reflexed angles, × 10. 4. Stem leaf from upper part of same stem as fig. 1; moist and under coverslip, × 10. 5. Stem leaf from upper part of same stem as fig. 1; moist and under coverslip, × 10. 6. Branch leaf from same stem as fig. 1, × 16. 7. Attachment of stem leaf showing moist base of leaf with reflexed angle, × 12 (approximately). 8. Basal and alar region of fig. 5, × 160. 9. Alar cells of different leaf from same stem (fig. 1) showing variation in shape, × 200. 10. Basal cell of fig. 5, enlarged to show pitted wall, × 370.

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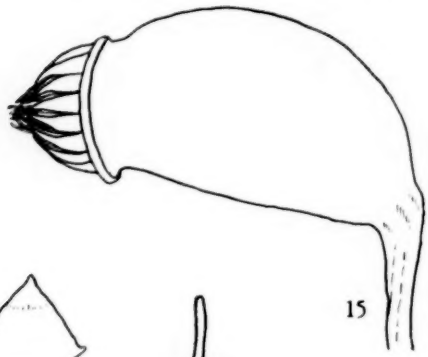

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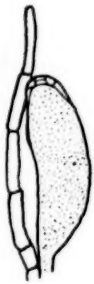

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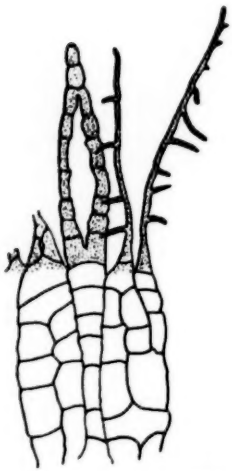

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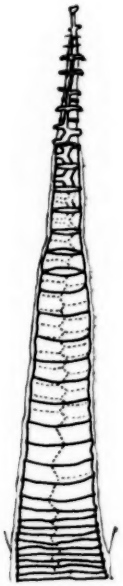

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and forked (*fig.* 4, 5), or occasionally double. Width of the leaf attachment area is commonly less than two-thirds the width of the leaf at its widest point; usually it is one-half or less.

BRANCH LEAVES. Branch leaves are wide-spreading, or even squarrose, to somewhat erect, especially on tapered branch ends. Branch leaves are concave; they range in size from 2 × 1 mm. to 2½ × 1½ mm. They are serrate below the apex and serrate or serrulate nearly to the base; they are more or less decurrent, but sometimes scarcely so. Alar cells are quadrate or short rectangular to somewhat inflated. Median cells are often shorter than in stem leaves. The costa is usually single and thin from a broad base (*fig.* 6); rarely is it completely double and very short and thin. Branch leaves have a more gradually acuminate leaf apex and a less broadly ovate leaf base than stem leaves. Lowermost branch leaves are much smaller and of different form from the other leaves (*fig.* 2).

GAMETANGIA. *Brachythecium hylotapetum* is consistently dioecious, although it very often appears to be sterile. Antheridia are borne in small budlike heads about 1 mm. long in the axils of some of the stem leaves (*fig.* 11). Of the several clusters dissected, about 12 antheridia were found in each head. The larger, unopened antheridia were about 350 μ long (*fig.* 12).

Archegonial heads are considerably larger than the male heads when mature, reaching 5 mm. long in the fruiting stage. When immature, the long-acuminate perichaetial leaves are erect and somewhat secund (*fig.* 13). At maturity these leaves become reflexed except for the innermost, which usually remain erect (*fig.* 14). Perichaetial leaves of archegonia are serrate, serrulate, or entire; cells in the costal region are slightly less hyaline, giving a semblance of a very weak costa.

SPOROPHYTE. Sporophytes have been very difficult to find except for one site, where they were abundant; however, fruiting plants have been studied from the extremes of the known range and are found to be consistent throughout the range. Selection of

FIG. 11-20. *Brachythecium hylotapetum*, all figures from type specimen. 11. Moist antheridial bud, × 20. 12. Moist, mature but unopened antheridium and paraphysis, × 75. 13. Moist young archegonial bud, × 30. 14. Moist perichaetial leaves, at base of mature sporophyte, × 4. 15. Dry, mature de-operculate capsule, × 24. 16. Dried loose operculum, × 16. 17. Same operculum as fig. 16, moist, × 16. 18. Outer peristome tooth, exterior view; actual size 462 μ × 84 μ (at base), × 178. 19. Tip of outer peristome tooth, exterior view, × 300. 20. Appendiculate cilia, segment of inner peristome, and basal membrane, inner view (note the perforate cilia base to the left of the segment), × 160 (approximately).

a specimen for the type of *Brachythecium hylotapetum* was from a heavily fruiting collection showing best the characters most clearly distinguishing the taxon: appendiculate cilia and dioecious gametophytes; however, gametophytic vegetative characters are better exemplified in a number of other specimens.

Cilia (*fig.* 20) are fragile and in old capsules may be broken. The appendiculae are visible under a good high-power dissecting microscope; if studied under a cover glass they must be viewed from the inside of the peristome by splitting the capsule. Cilia are 2, 3, or 4 in number and long, about as long or longer than the segments, mostly longer when not broken; in the type they ranged from 124 μ to 266 μ, measured from the top of the basal membrane; they are hyaline and papillose. Cilia may, at times, be perforate at the base (see at left of *fig.* 20). The appendiculae, when viewed from the best angle, are very long and slender (*fig.* 20). Segments of the inner peristome are sometimes widely gaping, sometimes only narrowly so, but always papillose; those in the type ranged from 280 μ to 308 μ long, including the basal membrane. The basal membrane is high, half the height of the peristome teeth; it is inserted about 70 μ below the top rim of the capsule; from the top of the rim of the capsule the basal membrane measured 210 μ in the type specimen.

Outer peristome teeth are long and slender (*fig.* 18), slightly longer than the inner peristome, and have very heavy divisural markings above (*fig.* 19). They range from 462 μ to 574 μ in length, measured from the top of the rim of the capsule.

Spores are 12 to 20 μ and have minutely roughened walls.

The annulus is irregular and compound with about 2 cells (1-3) in a row, not persisting when the capsule is fully mature. Cells of the capsule wall below the annulus are round or rounded-hexagonal for about 3 rows; below these the cells in some capsules may be more elongate or in others round or rounded-hexagonal.

The operculum is ordinarily high-conic mammillate, with a minute black apiculus. This apiculus remains distinct whether wet or dry once the operculum is detached (*fig.* 16, 17), but opercula in position on the capsule have been seen without this apiculus, the tip then being blunt. The upper one-third of the operculum usually is blackish. The remainder of the operculum may be a bright chestnut color, sometimes blackish spotted, or sometimes dark throughout.

Capsules (*fig.* 15) are variable in size, sometimes small, very short, and nearly erect, or they may be much larger, to 2½ mm. or

perhaps more, and horizontal. The larger capsules are usually light colored with blackish dots. After loss of the operculum, capsules are constricted below the mouth when mature and dry. Capsules when dry are usually more or less gibbous on the upper side just above the seta, the slight protuberance ordinarily accompanied by a wrinkling of the tissue when thoroughly dry (*fig.* 15).

The seta may be short, about 1 cm., or more often as much as 3 cm., or perhaps more. Its color varies from chestnut to purple-red. It is regularly papillose throughout with low blunt papillae. Sometimes these papillae are so low that the seta must be soaked to bring them out properly.

Distribution and Ecology

Type locality: Forest roadside soil, *Thuja-Tsuga/Pachistima* association. Granite Creek near Priest Lake, about 5 miles from Nordman, Bonner Co., Idaho, T62N R5W. May 29, 1955. Type specimen: *N. & B. W. Higinbotham* 82, in herb. State College of Washington (208696); isotypes (broken from the same specimen) in the collections of Dr. Henry S. Conard and of the authors.

Some specimens of *Brachythecium hylotapetum* already deposited in herbaria under other names are listed in detail in another paper (Higinbotham, 1958). County records supplied by these and by the authors' own collections are given here, although no attempt is made to list all of the specimens collected; instead, a sample specimen only is cited for each county.

Washington. Asotin Co. *Hig.* 326 (WS 208884); Chelan Co. (see Higinbotham, 1958: *Grant* 8133); Clallam Co. (see Higinbotham, 1958: WTU 545); Columbia Co. *Hig.* 344 (WS 208882); Lewis Co. *Hig.* 341 in WS (208880) only; Pend Oreille Co. *Hig.* 343 (WS 208881); Snohomish Co. (see Higinbotham, 1958: *Mosses of the Sound Country*, Bailey); Stevens Co. *Hig.* 337 (WS 208877); Whitman Co. (see Higinbotham, 1958: *Jones* 860).

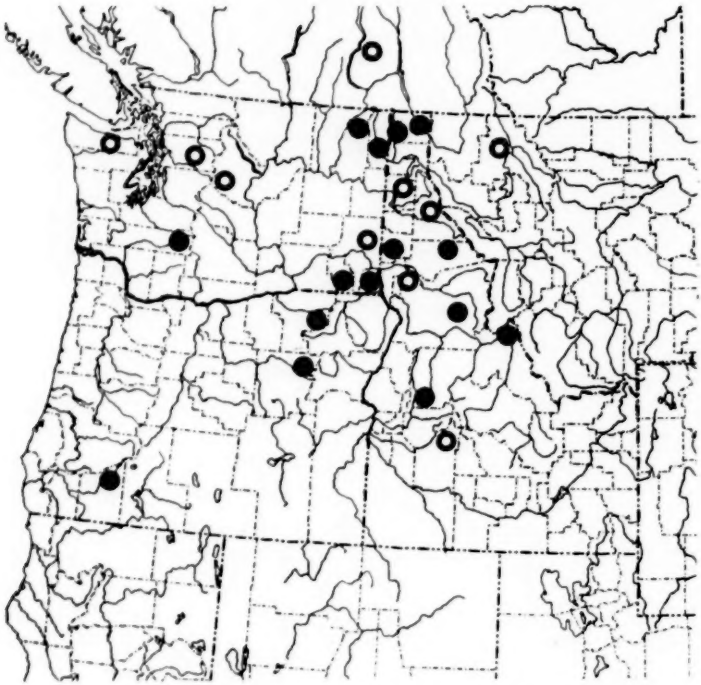
Idaho. Bonner Co. Type: *Hig.* 82 (WS 208696); Boundary Co. *Hig.* 346 (WS 208885); Clearwater Co. *Hig.* 97 (WS 208709); Elmore Co. (see Higinbotham, 1958: *MacFadden* 19027); Idaho Co. *Hig.* 122 (WS 208815); Kootenai Co. (see Higinbotham, 1958: *West American Mosses, Leiberg* 116); Latah Co. *Hig.* 345; Lemhi Co. *Hig.* 350 (WS 208887); Lewis Co. (see Higinbotham, 1958: *Cooke* 25007); Shoshone Co. *Secor* 59 (WS 218525) as *Brachythecium rutabulum;* Valley Co. *Hig.* 347 (WS 208886).

Montana. Flathead Co. [see under taxonomy (*Williams* 170), and in Higinbotham, 1958: Grout's *Musci Perfecti* 223].

Oregon. Grant Co. *Hig.* 339 (WS 208879); Jackson Co. *Hig.* 338 (WS 208878); Umatilla Co. *Hig.* 340 (WS 208883).

British Columbia. Sandon (see Higinbotham, 1958: *MacFadden* 589, 590).

The known distribution of this taxon is shown on map 1.



MAP 1. Distribution by county of *Brachythecium hylotapetum* in Washington, Oregon, Idaho, western Montana, and southern British Columbia. Hollow circles represent specimens collected by others; solid circles represent the authors' own collections. Each circle represents one or more collections.

Brachythecium hylotapetum occurs from the Olympic Peninsula east to Montana and from Oregon north to British Columbia. It has been found on the western slope of the Rocky Mountains in northern Montana, in the Selkirk Mountains of northern Idaho and northeastern Washington, in the Blue Mountains of southeastern Washington and northeastern Oregon, in the Selway-Bitterroot Mountains of north-central Idaho, in the Cascade Mountains, the Olympic Mountains, and in other mountain areas. Thus, from the Rocky Mountains to the Pacific Ocean it has been found in all of the major mountain ranges in the Pacific Northwest.

Brachythecium hylotapetum has been found on litter, duff, rotting wood, and occasionally on rocks and on mineral soil on the

floor of evergreen forests. It has not been found in an aquatic habitat. It has been always present in northern Idaho forests in which *Abies grandis* is abundant; it is also present in certain types of *Abies lasiocarpa* stands. In northernmost Idaho (Bonner and Boundary Counties) and northeastern Washington (Pend Oreille County) it was also found regularly in mature *Thuja-Tsuga/Pachistima* forests (forest classification based on Daubenmire, 1952).

Taxonomy

This species is very closely related to some of the species of *Cirriphyllum* and perhaps could have been placed in that genus in the section not having long-rostrate opercula. In Grout's *Moss Flora*, this species would commonly key out to *Cirriphyllum* because of the usually strongly concave leaves. It would be separated from any *Cirriphyllum* likely to be confused with it by the mammillate operculum and/or the appendiculate cilia. The genus *Cirriphyllum* seems to be very loosely defined at present, and a reorganization of it and of *Brachythecium* seems necessary for a clear understanding of the complex. Until then, it seems best to keep this taxon in the genus *Brachythecium* with species with which it has very close relationships.

In the genus *Brachythecium*, as given by Brotherus (1925) in Engler and Prantl's *Die natürlichen Pflanzenfamilien*, *B. hylotapetum* seems most closely related to the subgenus Eubrachythecium, section Rutabula, and would be associated with the dioecious species including *B. asperrimum* Mitt., *B. rivulare* BSG, *B. latifolium* (Lindb.) Philib., *B. lamprochryseum* C.M. & Kindb., and *B. washingtonianum* Grout. From *B. asperrimum*, *B. latifolium*, *B. rivulare*, and *B. washingtonianum* it is distinguished by the strongly appendiculate cilia and by other characters: *e.g.*, in *B. rivulare* the habitat and ecology are completely different. From *B. lamprochryseum* it is distinguished by the strongly concave leaves which are very different in form, by the costa, and by the operculum. From many of these species it differs also in general appearance. It resembles *Brachythecium rutabulum* (Hedw.) BSG and its varieties very closely, but is separated by its dioecious character, appendiculate cilia, and less papillose seta.

It should be noted that many of the specimens identified as *Brachythecium nelsoni* Grout by Grout himself are not conspecific with the type of *B. nelsoni*. In the type specimen (at Duke University) the only peristome is broken. Therefore—to preserve in the literature a feature not noted in print before (to our knowledge)—we call attention to the fact that, though broken, two cilia

show appendiculae; however, these are not long and slender as in *B. hylotapetum* but instead appear to be short and thick. This seems to refute Grout's own description "Sporophyte not differing essentially from *B. rivulare*." Persson (1946) has stated that *B. nelsoni* and *B. latifolium* are identical, but according to the description, *B. latifolium* does not have appendiculate cilia. An error must also have been made in the original description of *B. nelsoni* concerning the size of stem leaves since Grout (1902) gave the size as "1.5-2 × about 0.6 mm." and in his *Moss Flora* (1928) as "about 1.5-2 by 0.6." Yet on the type specimen no stem leaves could be found less than 1 mm. wide at the widest point.

The discovery of appendages on cilia of the type specimen of *B. nelsoni* indicates that it may not be identical with *B. latifolium*. In view of discrepancies between the type and the description of *B. nelsoni* it appears that the taxon requires further study. Careful examination of the type specimen, however, has convinced the authors that despite many features of resemblance with *B. hylotapetum* the latter is distinct as a taxon. A comparison follows:

B. nelsoni Type	*B. hylotapetum*
Plant size: Smaller, about the size of *B. albicans* (Hedw.) BSG.	Robust, about the size of *B. rutabulum* (Hedw.) BSG or larger.
Stem leaf size: Smaller 1⅕-2⅓ × 1⅓ mm.	Larger, 2⅓ × 1½ to 3⅔ × 2 mm.
Stem leaf shape: Strongly triangular, upper half gradually tapered from below; leaf somewhat concave.	Broadly ovate shape, upper half broader, apex more abrupt; upper leaves almost always strongly concave above.
Stem leaf attachment: Broad, often ⅔ or more the width of the leaf at its widest point.	Insertions usually narrow and less than ⅔, commonly ½ or less the width of leaf at its widest point.
Alar region: Large and well defined area, occupying a broadly triangular region.	Smaller, less well defined area, not triangular, with cells more graduated.
Spore size: 16.5-19.8 μ (based on a measurement of 12 spores).	12.42-19.6 μ (based on a large number of spores, many of them in the smaller size range but with considerable variation).
Operculum: Sharply acute, more elongate.	Mammillate-apiculate but not sharply acute, less elongate.
Capsule: No apophysis.	Apophysis usually indicated by slightly gibbous base on upper side of capsule near seta.
Cilia: Appendiculate with short, broad processes (regularly?).	Appendiculate with long slender processes.

Over much of its area *Brachythecium hylotapetum* very commonly grows in association with *B. curtum* (Lindb.) Lindb., a

moss that has been identified as *B. collinum* var. *idahense* (Ren. & Card.) Grout, among other things; however, *B. curtum* was the determination made by H. Persson (personal correspondence). In the fresh moist condition in the forest it may at times be rather difficult to distinguish small forms of *B. hylotapetum* from *B. curtum* since moist leaves of *B. curtum* stand out in such a way as to make the plants seem very much larger than when dry. *B. curtum*, however, is monoecious, and in the form in which it grows in the Pacific Northwest of America, it dries at the ends of the stems and branches in a strongly secund, almost falcate form; whereas *B. hylotapetum* commonly dries complanate but never secund or falcate; moreover, the dried apical stem bud of *curtum* is tapered while that of *hylotapetum* is large and bluntish.

Extremely vigorous plants of *B. hylotapetum* (e.g., *Hig.* 329) may superficially resemble *Rhytidiopsis robusta* or *Plagiothecium undulatum*. When the forest floor is relatively dry and the plants not in vigorous condition, the gametophyte may resemble large specimens of *Plagiothecium denticulatum*.

Specimens of *Brachythecium hylotapetum* have been variously identified as *B. rutabulum* forma, *B. rutabulum* var. *flavescens*, *B. nelsoni*, and *Cirriphyllum cirrosum* var. *coloradense*. Characters of *B. hylotapetum* distinguishing it from these forms have been discussed above. False distribution records based on these misidentifications are emended in another article, where additional herbarium specimens of *B. hylotapetum* are listed (Higinbotham, 1958).

An interesting feature in the history of *Brachythecium hylotapetum* is concerned with a specimen that R. S. Williams sent to Dr. Grout. The specimen, now in the herbarium of Duke University (no. 75749), contains the following note that Williams pencilled on a slip within the packet: "This is not described as far as I know, May 4, 1895, Columbia Falls, 170, R. S. Williams." Then, on another pencilled slip in the same handwriting, but with a parenthetic addition initialed by Dr. Grout, is the following: "Dioicous (the only character separating from *B. rutabulum flavescens* A.J.G.). Pedicel Rough, about three appendiculate cilia, Conpound [*sic*] annulus, Leaves more or less complanate with much the habit of *Plagiothecium undulatum*."

Although Williams pointed out the exact characters that separate this taxon from any other closely related, including *B. rutabulum* var. *flavescens*, Grout noted only one and apparently thought it was insignificant since he packeted the moss with a label

reading "*Brachythecium rutabulum flavescens*, Det. A.J.G." The printed head of the label reads, "Rev. N. A. Brachytheciaceae, A. J. Grout." It is this confusion that must have caused Grout to add to his material on *B. rutabulum* var. *flavescens* in the *Moss Flora* (1928): "This variety seems imperfectly dioicous, as both Kindberg and R. S. Williams describe it as dioicous." The Kindberg specimen which Grout says is Macoun's 287 cannot be *B. hylotapetum* because Kindberg (Macoun, 1892) described it as having cilia not appendiculate; Williams specimen 170, however, actually is *B. hylotapetum*. Other specimens of *B. hylotapetum* that have been labeled as other species and, in some cases, distributed as parts of exsiccatae, are itemized in another paper (Higinbotham, 1958).

The authors are grateful to the several curators and bryologists who have been generous and most cooperative in lending specimens.

LITERATURE CITED

BROTHERUS, V. F. 1925. Musci. *In* Engler & Prantl, Die natürlichen Pflanzenfamilien. Ed. 2. Vol. 11. Leipzig.

DAUBENMIRE, R. 1952. Forest vegetation of northern Idaho and adjacent Washington, and its bearing on concepts of vegetation classification. Ecol. Monog. *22*: 301-330.

GROUT, A. J. 1902. *Brachythecium nelsoni*, n. sp. THE BRYOLOGIST 5: 76.

———. 1928. *Moss Flora of North America North of Mexico*. Vol. 3, part 1. Newfane, Vt.

HIGINBOTHAM, BETTY WILSON & N. HIGINBOTHAM. 1958. Notes on specimens of *Brachythecium* and *Cirriphyllum* from the Pacific Northwest. THE BRYOLOGIST 61: 350-355.

MACOUN, J. & N. C. KINDBERG. 1892. Catalogue of Canadian Plants. Part 6—Musci. p. 195. Montreal.

PERSSON, H. 1946. Some Alaskan and Yukon bryophytes. THE BRYOLOGIST 49: 41-58.

NOTES ON SOME SPECIMENS OF BRACHYTHECIUM AND CIRRIPHYLLUM FROM THE PACIFIC NORTHWEST

BETTY WILSON HIGINBOTHAM and N. HIGINBOTHAM[1]

Literature dealing with the distributions of *Brachythecium rutabulum* (Hedw.) BSG, *B. rutabulum* var. *flavescens* (Brid.) BSG, *B. nelsoni* Grout, and of *Cirriphyllum cirrosum* var. *coloradense* (Aust.) Grout indicates that these taxa occur in the Pacific

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Northwest. These records, however, may be questioned since recent work on a new species, *Brachythecium hylotapetum* Hig. (Higinbotham, 1958), revealed that many of the specimens of this new species were filed in herbaria under various other names—particularly those cited above.

Most of the specimens of *Brachythecium hylotapetum* had been identified in the past as *B. rutabulum* and its varieties. It soon became evident that *B. rutabulum* is very scarce, if present at all, in the Pacific Northwest, in contrast to the distribution given by Paris (1904), Grout's *Moss Flora* (1928), and others. Kindberg (see Macoun, 1892) said of *B. rutabulum* "This species is probably rare in Canada and often confounded with other ones." This is certainly true also of the Pacific Northwest.

None of the specimens examined of *Brachythecium rutabulum* from the Pacific Northwest were definitely *B. rutabulum*. Good specimens examined were other species or even other genera. Very often they were *B. hylotapetum*.

Some important specimens that have been annotated by one of the present authors are reported here, and it should be noted that if the following specimens constitute the basis for including Montana in the range for *B. rutabulum* in Podpěra (1954) then this citation should be voided for the taxon.

Specimens Labeled Brachythecium Rutabulum

N. Am. Musci Perfecti 223, issued by A. J. Grout; coll. & det. by R. S. Williams as *B. rutabulum* var. *flavescens*. Columbia Falls, Montana. May-July, 1907. Two specimens of this collection have been examined, one from the University of Washington, one from Washington State College (2135). Both are typical examples of *B. hylotapetum*. Williams' collection represents one of the easternmost collections known for *B. hylotapetum*.

Rev. N. A. Brachytheciaceae, A. J. Grout. *Brachythecium rutabulum flavescens*, det. A. J. G., herbarium of A. J. Grout, Duke University 75749. This is an important specimen and contains historically interesting notes that are quoted in full in the paper describing *B. hylotapetum*, where some confusion concerning *B. rutabulum* is given attention in a discussion of this and other specimens (Higinbotham, 1958). Williams number for this is 170, Columbia Falls [Montana], May 4, 1895. This specimen is *B. hylotapetum*. Another specimen bearing what appears to be number 170 was also collected by Williams at Columbia Falls, Montana, but bears the date Oct. 28, 1891. It has the printed label: "*North American Mosses*. Rocky Mountains" (Duke 75409). It

also is *B. hylotapetum*, although originally labeled "*Br. rutabulum flavescens* Br. & Sch."

Allen's "*Mosses of the Cascade Mountains, Washington.* J.A.A." 107 (Allen's field no. 134): coll. by J. A. Allen "on partly decayed sticks and leaves, Mr. Rainier. June 1899; det. by A. J. Grout" as *B. rutabulum* var. *flavescens*. The Washington State College specimen (589) bears an additional label: "Revision of North American Mosses, for systematic botany of N. A. . . . examined by E. G. Britton" and in handwriting: "= *Brachythecium platyclada* Kindb. fide R. S. Williams & E.G.B.—good species." One University of Washington specimen of this collection (no acquisition number) has a handwritten label with a note: "A poor sterile form of a species common in the Eastern States. O.A.A." This specimen is almost entirely made up of another *Brachythecium* species and has only a very small amount of *B. hylotapetum*. Another specimen at the University of Washington has the number 569 added to the label; it contains a larger amount of *B. hylotapetum*. *Brachythecium platycladum* C. M. & Kindb. was considered by Grout to be a synonym of *B. rutabulum* var. *flavescens*. Both *B. platycladum* and *B. rutabulum*, however, are described as having the cilia not appendiculate; the Washington State College (589) specimen has distinctly appendiculate cilia and therefore should not be classified as either of these regardless of whether the names are synonyms. These specimens of Allen's—including two at Duke University (Duke 13683 and 75463)—each contain *B. hylotapetum* in small or large proportion with frequently other taxa present; they do not contain *B. rutabulum*.

Herbarium University of Washington, no. 545: Olympic Mts., Washington, Aug. 7, 1907. Ellwha River valley; near mouth of Godkin Creek; alt. 2511 feet; on soil in river bottom, coll. T. C. Frye, det. J. W. Bailey as *Brachythecium rutabulum*. This is *B. hylotapetum*.

Fay A. MacFadden 19027 (Duke 128839 and 128876; WTU, no acquisition number): Boise Nat. Forest, in China Basin, Atlanta, Idaho, coll. Fay A. MacFadden, July 9, 1942 as *Brachythecium rutabulum* var. *flavescens*. The leaves are more tapered than usual but even without fruit this can be said to be *B. hylotapetum*.

Mosses of the Sound Country, Herbarium of Dr. John W. Bailey (WTU, no number); no collection number. "On humus in trees along banks of Skykomish River above Index, Wash., 9-14-32," as "*Brachythecium rutabulum flavescens* (Brid.) B. &

S." Another specimen of the same moss with an identical label except that it reads "among trees" instead of "in trees" is also at the University of Washington Herbarium. Both specimens are *B. hylotapetum*.

Mosses of the Sound Country, Herbarium of Dr. John W. Bailey, presented to the University of Washington by John W. Bailey; no number. "In woods, Big 4, Snohomish Co., Wash. 7-30-31. Det. A. J. Grout," as "*Brachythecium rutabulum flavescens* (Brid.) B. & S." This is fruiting material and is typical *B. hylotapetum*.

"*Presented to the University of Washington by John W. Bailey* [no number] . . . Big Four, Washington, Bank of Perry Creek, coll: John W. Bailey; July 13, 1931," as "*Brachythecium rutabulum flavescens*." This is *B. hylotapetum*.

"'*Ex Herbario Wm. Bridge Cooke*, Idaho, Lewis County [WTU] . . . On the ground, *Pinus ponderosa-Symphoricarpos* Association, Ponderosa Pine Zone. Moderately open climax forest, well drained upland. East side of Winchester. T34N., R.2W., S. 31. Collectors: W. B. & V. G. Cooke 25007, 5 April 1949." As *Brachythecium rutabulum* var. *flavescens*. This is nonfruiting *B. hylotapetum*.

"*Ex Herbario Wm. Bridge Cooke*, Idaho, Lewis County [WTU] . . . On the ground, *Pinus ponderosa-Symphoricarpos* Association Ponderosa Pine Zone . . . Collectors: W. B. & V. G. Cooke 25003, 5 April 1949," as "*Brachythecium rutabulum flavescens* [and] *Br. albicans*." That portion of the specimens identified as *B. rutabulum* var. *flavescens* is *B. hylotapetum*.

"*Herb. J. M. Grant*, Blewett Pass Region, on log, Hab. Cascade Mountains, Washington. Coll. J. M. Grant, Aug. 1929," as *Brachythecium rutabulum* (WTU, no number). This is *B. hylotapetum* and probably a duplicate of the following.

"*Herb. J. M. Grant* 8133." "On log Blewett Pass, Hab. Cascade Mountains, Washington. Coll. J. M. Grant, Aug., 1929," as *Brachythecium rutabulum*. This is *B. hylotapetum* and probably a duplicate of the above. It was presented to the University of Washington by John W. Bailey.

"*West American Mosses* 116 [Duke 75769]. On the ground in deep shady cold woods—Lake Pend d'Oreille Traille River Basin. Dec. 1888. Coll. J. B. Leiberg, Kootenai Co., Idaho," as "*Brachythecium*" . . . "*rutabulum flavescens* A.J.G." (the last quotation is in a different handwriting from that on the rest of the label). This specimen is dioecious and has appendiculate cilia; it is *B. hylotapetum*.

MacFadden 590 Star Trail, Sandon, B. C. (Grout Herbarium: Duke 75793) "If this is *B. rutabulum flavescens* I think I can get enough for you." (Collectors name not on packet, but readily identifiable by adjacent packets on sheet.) This specimen is *B. hylotapetum* and was named "*Brachythecium rutabulum flavescens*" and annotated "near it" (this last quotation probably in Grout's handwriting).

MacFadden 589 (Grout Herbarium: Duke 75741) "Sandon, B. C., May 1926. F.A.M., as "*Brachythecium rutabulum flavescens*," and annotated as "close to it" (this last quotation probably in Grout's handwriting). The specimen is *B. hylotapetum*.

MacFadden 379 (Grout Herbarium: Duke 75740) "Halcyon Hot Springs, Arrow Lakes, B.C. April 16, 27, F.A.MacF.," as "Brachythecium? . . . *rutabulum flavescens*" (the species and variety added in pencil). This is *B. hylotapetum*.

Flora of Washington. C. V. Piper (WS 590) "June 3, 1893, on moist rocks. Almota, Wash." Det. by T. C. Frye as *Brachythecium rutabulum*, and by G. N. Jones as *B. oxycladon*. Another specimen (WS 588) bears Piper's number 250 and reads on "moist cliffs" instead of "moist rocks." Both labels otherwise read the same, including identifications. The determination as *B. oxycladon* may have been made on the basis of an underlying fruiting *Amblystegium*. The overlying moss is dioecious and should not be classified as *B. rutabulum;* nor should it be *B. oxycladon* since even fruits lying free in the specimen show an annulus, so that any range extension based on this specimen (as in Jones, 1929) should be voided. The overlying moss, though not fruiting, is probably *B. lamprochryseum* C.M. & Kindb.

Flora of Washington. C. V. Piper (WS 591) "in wet meadows. Seattle, March, 1892," as *Brachythecium rutabulum*. This specimen is probably *B. washingtonianum*, although sterile.

Specimens Labeled Cirriphyllum cirrosum var. coloradense

Citations of *Cirriphyllum cirrosum* var. *coloradense* from Washington and Idaho should be reviewed most carefully. No specimens have been seen by the authors that did not prove to be something else. One record cited in Grout's *Moss Flora* (Vol. 3, part 4, Additions and Corrections) can definitely be rejected: *Geo. N. Jones 860* (WTU, no acquisition number) "on soil in moist woods, n. side Kamiak Butte, Whitman Co., Wash., May 12, 1928, Det. A. J. Grout, Jan. 1929," as *Cirriphyllum cirrosum* var. *coloradense*.

This specimen is typical *Brachythecium hylotapetum*. A duplicate of this from Grout's herbarium (Duke 97878) has, in what is probably Grout's handwriting: "*Cirriphyllum cirrhosum coloradense* (Aust.) Grout. Leaves shorter acuminate than in the type."

Specimens Labeled Brachythecium nelsoni

Not all specimens examined under this name have been readily identified, because some are incomplete or degenerate, or because of incomplete understanding of the genus *Brachythecium* and its allies—a complex which requires further taxonomic study, particularly in the group including *B. nelsoni* (or *B. latifolium*, according to Persson, 1946; but see Higinbotham, 1958, where discrepancies between the type specimen of *B. nelsoni* and Grout's description are noted). Grout himself appeared to be in doubt about some of his Idaho specimens of *B. nelsoni* for he added a question mark on one packet, "forma probably" on another, and "not well developed" on another.

Summary

Unless there are clear-cut specimens to substantiate their presence, it appears that *Brachythecium rutabulum* (Hedw.) BSG and *B. rutabulum* var. *flavescens* (Brid.) BSG do not occur in the Pacific Northwest; that *Cirriphyllum cirrosum* var. *coloradense* (Aust.) Grout may not occur in Washington or Idaho; and that *Brachythecium nelsoni* Grout is of doubtful occurrence in Idaho. A record for *B. oxycladon* (Brid.) Jaeg. & Sauerb. for Washington is rejected.

Literature Cited

Grout, A. J. 1928, 1934. Moss Flora of North America North of Mexico. Vol. 3(1, 4). Newfane, Vt.

Higinbotham, Betty Wilson & N. Higinbotham. 1958. *Brachythecium hylotapetum* n. sp. The Bryologist 61: 339-350.

Jones, G. N. 1930. The moss flora of southeastern Washington and adjacent Idaho. Research Studies of the State College of Washington. Vol. 1, no. 4, part 2. 155-192.

Macoun, J. & N. C. Kindberg. 1892. Catalogue of Canadian Plants. Part VI—Musci. Montreal.

Paris, E. G. 1904. Index Bryologicus sive Enumeratio Muscorum. Ed. 2, Vol. 1.

Persson, H. 1946. Some Alaskan and Yukon bryophytes. The Bryologist 49: 41-58.

Podpěra, J. 1954. Conspectus Muscorum Europaeorum. Práce Československé Akademie Věd.

MOLENDOA SENDTNERIANA IN THE UNITED STATES[1]

ZENNOSKE IWATSUKI and AARON J. SHARP[2]

On December 31, 1956, while collecting bryophytes on the limestone bluffs along Little River between Townsend and the boundary of the Great Smoky Mountains National Park in Blount County, Tennessee, we repeatedly found in moist crevices a sterile, travertine-forming moss which superficially resembled *Gymnostomum* or *Hymenostylium*. Closer examination revealed that it did not belong to these genera because the leaves were too slender and upon drying they became as crisped and contorted as those of *Trichostomum cylindricum*, from which it differed in smaller size and darker, more bluish color.

Subsequent microscopic examinations led only to disagreement between the collectors as to its identity, and duplicates were submitted to six other moss students. Only two agreed as to its generic identity. Further study indicated that these two were right in calling it *Molendoa* as had the senior author.

Search of the literature revealed that only one species of *Molendoa* had been reported (Grout, 1937, pp. 150-151, as *Anoectangium*) from the United States: *M. obtusifolia* Broth. & Par. is listed from Arizona and Texas and appears to be abundant southward in Mexico (Crum, 1951). The Tennessee material, however, proved to be *M. sendtneriana* (BSG) Limpr., known previously from Japan, Formosa, China, Kashmir, eastern Siberia, the Caucasus and Europe.

Noting its resemblance to other genera, including *Trichostomum*, we initiated a search in the herbarium of the University of Tennessee and found six collections masquerading as aberrant forms of *Trichostomum cylindricum*. Dr. Lewis E. Anderson furnished two more collections from the Duke University Herbarium and Mr. Alfred Clebsch presented us with six more from his herbarium. (We are grateful to Dr. Anderson and Mr. Clebsch and also to Dr. A. LeRoy Andrews and Dr. A. Noguchi for comparative materials.) We suspect that there are additional collections from southeastern United States in other herbaria filed under *Trichostomum*, *Gymnostomum* or *Hymenostylium*. At present we can

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report 15 collections (all sterile) of *M. sendtneriana* from Tennessee, North Carolina and Florida:

TENNESSEE. *Sharp* 34183, shale cliff, Kinzel Springs, Blount Co., 18 Mar. 1934; *Bold & Sharp* 34290, rock cliff, Sycamore Creek, Cheatham Co., 30 Mar. 1934; *Sharp* 34422, marble wall of sinkhole, Love Creek, Knox Co., 1 May 1934; *Sharp* 341046, White Oak Sink in Great Smoky Mountains National Park, Blount Co., 22 Aug. 1934; *Sharp s. n.*, limestone, Cave Spring towards Wears Cove from Townsend, Blount Co., 14 Aug. 1942; *Clebsch* 528, limestone bluff, Red Rocks Bluff, Montgomery Co., 12 Jan. 1946; *Clebsch* 850, seeping base of bluff along Cumberland River above Seven Mile Ferry, Montgomery Co., 2 Apr. 1950; *Clebsch* 13163, wet recess near stream, near Old Powder Mill on Sycamore Creek, Cheatham Co., 16 Mar. 1952; *Clebsch* 13218, seep from cracks, bluffs of Sulphur Creek, Montgomery Co. near Robertson Co. line, 22 Feb. 1953; *Clebsch* 14156, seep in limestone, Cumberland River bluff, 2½ mi. SSE of Clarksville, Montgomery Co., 7 Jan. 1956; *Sharp & Iwatsuki* 5624, Wet crevices of calcareous bluff along Little River above Townsend, Blount Co., 31 Dec. 1956; *Iwatsuki & Sharp* 1615, limestone bluff, White Oak Sink, Blount Co., 1 Sept. 1957.

NORTH CAROLINA. *Anderson* 9813, marl outcrop, shaded ravine, along Trent River, NE of Pollock, Jones Co., 27 May 1951; *Anderson & Jones* 9705, vertical limestone cliff, Linville Caverns near Linville Falls, McDowell Co., 27 Aug. 1951.

FLORIDA. *Pursell* 300MF14, on limestone at cave's exit, Florida Caverns State Park, Jackson Co., 16 Apr. 1958.

For those who may search in either field or herbarium for this species, a discussion of its differences from other genera follows: Its very slender leaves (*Fig.* 2, 4, 5) are much more crisped on drying than the shorter leaves of either *Gymnostomum* or *Hymenostylium*. *Trichostomum cylindricum* is usually larger with a more yellowish tinge. *Molendoa* has one or two large papillae per leaf cell (*Fig.* 6), while *Trichostomum cylindricum* has three or more small papillae per cell (*Fig.* 14). The latter has abruptly acuminate leaf-apices (*Fig.* 9, 11, 12) while the former has leaves which taper very gradually to the tip (*Fig.* 2, 4, 5). Moreover, these two species may be easily distinguished by observing the basal cells: the basal quarter of the leaves of *T. cylindricum* consists of rectangular, elongated and hyaline cells (*Fig.* 13) while elongated basal-cells are few and inconspicuous (*Fig.* 7) in leaves of *M. sendtneriana*. Furthermore, *M. sendtneriana* has two stereid bands and two rows of enlarged cells below the upper layer in the costa (*Fig.* 1, 3); in contrast, the anatomy of the costa in *T. cylindricum* is variable but never has the combination described above (*Fig.* 8, 10). Usually the *Trichostomum* leaves have two stereid bands, but this is not true of Grout's *North American Musci Perfecti* 116, nor of one of Steere's specimens from Michigan (Mt. Bohemia, Keweenaw Co., Sept. 1, 1937).

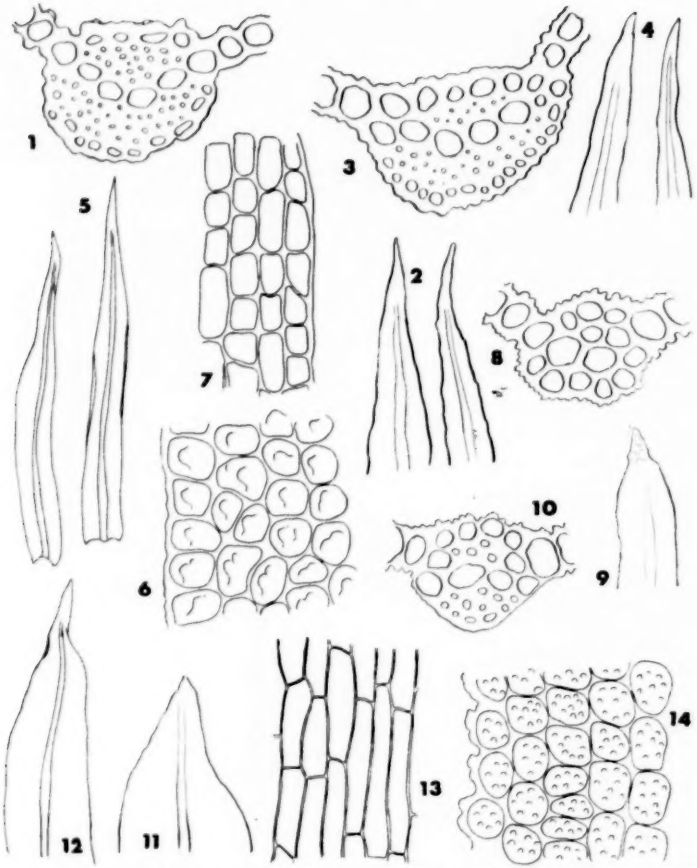

FIG. 1-7. *Molendoa sendtneriana*. 1. Cross-section at mid-leaf, × 192. 2. Leaf tips, × 45. 3. Cross-section at mid-leaf, × 192. 4. Leaf tips, × 45. 5. Leaves, × 10. 6. Cells at mid-leaf, × 303. 7. Basal leaf cells, × 303. Fig. 1, 2, 5-7 from Tennessee (TENN 5624), 3, 4 from Switzerland (*Culmann*). FIG. 8-14. *Trichostomum cylindricum*. 8. Cross-section at mid-leaf, × 192. 9. Leaf tip, × 45. 10. Cross-section at mid-leaf, × 192. 11, 12. Leaf tips, × 45. 13. Basal leaf cells, × 120. 14. Cells at mid-leaf, × 303. Fig. 8, 9 from Vermont (*N. Amer. Musci Perf.* 116), 10-14 from Mt. Leconte, Tenn. (TENN 35306).

Exsiccati of Tennessee collections by Iwatsuki and Sharp are being distributed by the American Bryological Society Moss Exchange.

LITERATURE CITED

CRUM, H. A. 1951. The Appalachian-Ozarkian Element in the Moss Flora of Mexico with a Checklist of all known Mexican Mosses. Univ. Microfilms 3486. Ann Arbor, Mich.

GROUT, A. J. 1937. Moss Flora of North America north of Mexico. 1: 150-151. Newfane, Vt.

THE GENUS TAKAKIA FOUND IN NORTH AMERICA

HERMAN PERSSON[1]

In the summer of 1957 I spent five and one-half weeks in the Queen Charlotte Islands, situated about 150 km. off the northern coast of British Columbia, with Alaska lying to the north. Only 13 bryophytes have been reported from the islands which extend more than 300 km. from north to south.

At my arrival in the islands a team of three botanists and one entomologist from the Department of Agriculture of Ottawa, under the leadership of Dr. J. A. Calder and Dr. D. B. O. Savile, were already there investigating especially vascular plants, fungi and insects. I had the great advantage of making practically all my excursions with these Canadian scientists, and I am very grateful to them for perfect collaboration. Indeed, without their good help, in every way, my results would have been much less.

From July 28 until August 2, with three colleagues I investigated the western part of Moresby I. on an excursion planned by the Canadian team. By means of a small hydroplane we reached "Alpine Lake," a small unnamed lake situated at 52° 55′ N. and 132° 03′ W. and at about 650 m. above sea-level. This was my only real opportunity to study alpine bryophytes in these islands where it is a real problem to reach the tree line because of steep topography and extremely dense vegetation.

"Alpine Lake" is situated just at the tree line which consists mainly of *Picea sitchensis* and *Tsuga heterophylla*. At the eastern end of the lake, in the lowest part of the alpine region, there were north-exposed slopes with rich alpine meadows. Along a small brook running through these meadows I collected a curious little plant that reminded me of nothing I had seen before.

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Early this year I began to study my collections from "Alpine Lake." On examination of the plant mentioned above I felt still more puzzled than when collecting it. Indeed, I hesitated whether to place it among the bryophytes or the algae. I was most inclined to consider it something between these two groups. Judge my astonishment when some two months later I received the preliminary report of *Takakia lepidozioides*, a bryophyte which Hattori and Inoue recently (1958) described and assigned to a new order, Takakiales, and a new family, Takakiaceae, and immediately recognized my curious find at "Alpine Lake." *Takakia* was first found in 1951 by Takaki at 2400 m. alt. on Mt. Shirouma, middle Japan, and was later collected in three other localities, all at high altitudes. Unfortunately, no reproductive organs were known from the Japanese plants.

In this connection I cannot account for the rather various interpretations of *Takakia* put forward by different bryologists. Some have thought *Takakia* an alga, but phycologists do not seem to think so. It seems evident that this plant belongs to the hepatics though absolutely isolated in that group.

A specimen was sent to Dr. Hattori, who wrote:

"I must inform you that I found several archegonia on the apical portion of stems in your collection of *Takakia*. I found only one archegonium per stem or once two rather isolated. No perianths, bracts or similar organs occur. I concluded the archegonia of *Takakia* are most similar to those of *Haplomitrium*, although in the latter as many as ten archegonia arise on the apical portion of stem. In shape and size they are similar to archegonia of *Calobryum*. (I cannot examine archegonia of *Haplomitrium*.) The *Takakia* archegonia mostly arise on the stem tip covered with crowded leaves, but rarely they occur below the stem tip, just like in *Haplomitrium* (also seldom seen in *Calobryum*). . . .

"I found some slight differences between Japanese material and Queen Charlotte material of *Takakia*. In cross section of leaves at middle, a single central cell is observed in Japanese material usually, whereas two or more central cells often in Queen Charlotte material. I illustrated this in my paper [as yet unpublished], but mentioned that the two plants should not be separated as distinct taxa, because of the poverty of material, and because such differences seem to be highly possible under different habitat conditions. Furthermore, the gametophytic characters of *Takakia* are supposed to be not well-defined genetically."

At "Alpine Lake" *Takakia* grew on soil, partly covering rocks, together with the following bryophytes: *Andreaea rupestris*, *Anthelia julacea*, *Calypogeia* cf. *trichomanis* (oil-bodies not available), *Diplophyllum albicans*, *Hypnum dieckii*, *Marsupella emarginata*, *Mnium* cf. *nudum* (under-developed), *Pellia neesiana* and *Pleurocladа albescens*, all indicative of a non-calcareous substrate.

The bryophyte flora along the brook and in its vicinity was of considerable interest. All the material is not yet studied, but I note, among others, *Anastrophyllum reichardtii, Brachythecium leibergii, Bryhnia hultenii, Campylopus atrovirens, Gymnomitrium crenulatum, Habrodon leucotrichus, Hygrobiella laxifolia, Lepidozia filamentosa, Lescuraea baileyi, Lyellia lescurii, Macrodiplophyllum imbricatum, M. plicatum, Marsupella alpina* (outside Europe known before only from one locality in southernmost Alaska; Persson, 1950), *M. stableri* (new to North America; known before only from Great Britain: "Wales and Westmoreland to Aberdeen, rare and almost confined to the west"; Macvicar, 1926), *Mnium nudum* and *Rhytidiopsis robusta.*

In this connection it may be worthwhile to state that those bryophytic elements which are confined to the North American as well as to the Asiatic side of the Pacific Ocean were very richly represented in the Queen Charlotte Islands, and particularly on the western side of the islands where the precipitation attains 5000 mm. and more. In this hyperoceanic region I collected, in one locality, the fern *Mecodium wrightii* (v.d.B.) Copeland, known before from Japan, Korea and Saghalin, and the first representative of the Hymenophyllaceae ever found in western North America.

LITERATURE CITED

HATTORI, S. & H. INOUE. 1958. Preliminary report on *Takakia lepidozioides.* Jour. Hattori Bot. Lab. 19: 133-137. *Fig.* 1-24.

MACVICAR, S. M. 1926. The Students Handbook of British Hepatics. Ed. 2. London.

PERSSON, H. 1950. *Marsupella alpina* (G.) Bernet, a new member of the group of hyperoceanic bryophytes in North America. THE BRYOLOGIST 53: 172-174.

REGENERATION IN BROTHERA LEANA

AKIRA NOGUCHI and HIROSHI FURUTA[1]

Brothera leana ranges widely in eastern North America and in Japan and China and extends into the Himalayas. In Japan it is rather common, being usually found on the base of such conifers as *Cryptomeria japonica* and *Chamaecyparis obtusa* in forested districts. Occasionally it grows also on rotten logs of the above trees or on dry rocks covered with soil. The senior author

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once came across this moss growing in a sunny place on the roof of a house made with the bark of *Chamaecyparis*. There may be a close relationship between the growth of this moss and coniferous trees. This moss usually forms a large compact cushion on the substratum. The sporophytes seem to be rare in Japan; the authors have never encountered any. In spite of this feature the geographic range of this moss is very wide. Reproduction is accomplished by means of propagula clustered at the tip of the stem. In order to clarify the mechanism of vegetative reproduction in *Brothera* the authors made cultures of the propagula and of detached leaves.

The plants were collected at Gokanosho, Kumamoto prefecture, Kyushu, in August 1955. They were kept in a small moist chamber until cultures were undertaken in the middle of October. Detached propagula and leaves were cultured on porous plates in the same manner as that described by Noguchi and Miyata (1957). In the present cultures the pH value of the medium was about 5.0. Plants growing on rocks at Chichibu, central Japan, were also cultured, and the results were almost similar to those obtained in the case of plants collected on bark at Gokanosho.

Regeneration of Propagula. The propagula are narrow and spindle-shaped with an acute end, measuring about 0.6 mm. in length and 0.05 mm. in breadth. The external appearance and the structural features of the propagula are similar to those of the leaves; that is, it may be noted that the propagula are hardly differentiated from leaves. Several longitudinal rows of chlorophyllose cell-chains in the center of the leaves are surrounded by an epidermal layer of large and hyaline cells.

Within three weeks of culture an epidermal cell of a propagulum gives rise to a protuberance which later develops into a filament. Preceding the formation of the protuberance it was observed that the cells bulged and were filled with chloroplasts. The development of the filaments was almost confined to both ends of the propagula. The filaments produced at the base of the propagula were slightly more numerous than those at the apex. At first the filaments were simple but later they produced many branches, and thus the protonema was established. The cells of filaments averaged 12 μ wide and were filled with chloroplasts. No differences were found between the main and branch filaments. The percentage of regeneration of propagula was only 18% after three weeks, but it became larger as time went on, being 60% after four weeks, 74% after seven weeks, and 82% after ten weeks. Buds of leafy plants appeared on the main or branch filaments in the

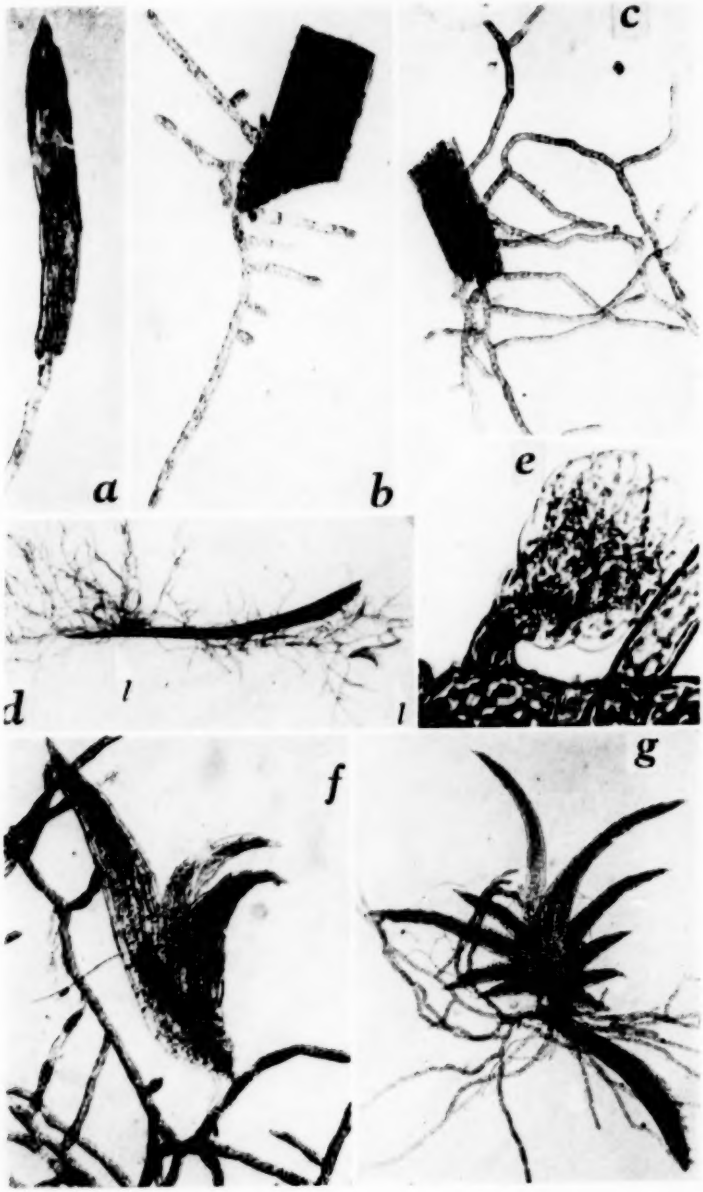
same manner as in leaf regeneration within three months after the treatment of propagula.

Regeneration of Leaves. As stated above, there were slight differences in the general appearance and the structure of leaves and propagula. On regeneration many chloroplasts were formed in the epidermal cells of leaves from which the filaments arose as in the case with propagula. The filaments were also similar to those developed from propagula. Development of the filaments was not confined to any particular portion of the leaves, but the filaments in the basal area of leaves were most numerous and were followed in abundance in the apical and middle areas. The percentage of regeneration of leaves was about 60% within one month after treatment and it increased to about 80% within two months. The filament from an epidermal cell of leaves was usually solitary; rarely two or three filaments were found. Juvenile filaments were simple, but they gradually produced many branches, resulting in the ordinary protonema. Considerable variations of growth were found among the filaments.

In order to clarify the degree of resistance to dryness, the leaves and propagula kept dry during four months were cultured. The leaves regenerated 27%, and the propagula 80%.

The germ cell of leafy plants appeared on the primary and the secondary filaments of protonemata within four months after treatment. One to four leafy plants were located on each filament. On formation of a juvenile plant, a cell of a filament cut off a short cylindrical cell which successively developed into two cells. The basal cell formed a bridge between the leafy plant and the filament. The end cell was divided into equal halves by a wall situated at a right angle to the first cross wall; then these two cells divided in three planes, and an obovoid cell mass was formed. Before long the cell mass gave rise to the first leaf and colorless rhizoids. Differentiation between the epidermal colorless and the inner chlorophyllose cells became evident in the juvenile leaves.

Regeneration of Mutilated Leaves. In order to clarify the relationships between regeneration ability and size of leaves, the following observations were made: Detached leaves were cut transversely into short segments and placed on the culture medium. The segments were made at random in various lengths between 50 μ and 500 μ. The appearance of filaments from the longer segments occurred within three weeks after the treatment, and the percentage regeneration was 44% after one month and 70% after two months. Generally the filaments from longer segments appeared earlier than those from shorter ones. The filaments


a
b
c
d
e
f
g

usually grew from cells on the cut surfaces or adjacent portions. The development, shape and size of filaments were similar to those of filaments from entire leaves. It was found that the shortest segments from which the filaments developed were 130 μ in length, though the appearance of filaments was considerably delayed.

Regeneration of Stems. When entire stems with leaves attached were cultured, they readily produced filaments at the mutilated ends, but scarcely on the entire surface of the stems. And also no filaments were produced from the attached and healthy leaves. This indicates that the separation of leaves from the stems is necessary to the development of protonemata.

Discussion and Conclusion

1. On regeneration, the filaments arose from the epidermal cells in both proximal and distal areas of leaves. The development of filaments is similar to that of other mosses, for instance, *Leucobryum brevicaule* (Noguchi & Miyata, 1957).

2. Development of filaments was not confined to any particular portion of the leaves, but the number of filaments developed in the proximal portion exceeded that in the distal. Meyer (1942) cultured cut segments from the distal, middle and proximal portions of leaves of *Physcomitrium turbinatum* and concluded that there were no differences of regeneration among these segments. On the contrary, Gemmell (1953) indicated that regeneration took place mainly in the distal third of leaves of *Atrichum undulatum*. This differs from the authors' observations on the leaves of *Brothera leana*. As already found by Noguchi and Miyata (1957), in certain species of mosses the development of filaments was confined to a particular area of the leaves, but in another species it was not confined to any definite area. Meyer observed that such short segments as one-third the length of a leaf produced filaments well. In *Brothera leana*, the cut segments of leaves easily produced filaments; the shortest segments from which the filaments arose were about 0.13 mm. in length.

3. Both propagula and leaves are resistant to dryness. It may be noteworthy that the propagula and leaves kept dry for four months produced good and extensive growth of filaments on the medium.

Fig. a-g. Regeneration in *Brothera leana*. a. A filament produced from the basal end of a propagulum, × 95. b, c. Filaments produced from segments of leaves, × 75, × 53, respectively. d. Protonemata produced from a detached but entire leaf, with leafy shoots at 1, × 10. e. A bud from a cell of a filament × 345. f. A leafy shoot established on a filament, × 74. g. A leafy shoot established on a filament of a detached leaf, × 33.

4. No filaments were produced from attached and unwounded leaves.

5. Gemmell (1953) mentioned that the regeneration of the leaves of *Atrichum undulatum* occurred on the lamellae in the distal third of leaves. It may also be noteworthy that such succulent leaves as those of *Brothera leana* and *Leucobryum* spp. (Noguchi & Miyata, 1957) readily regenerated on the nutrient media. Thus it may be found that certain relations exist between the great ability of asexual reproduction of these sterile mosses and their wide geographic range.

LITERATURE CITED

GEMMELL, A. R. 1953. Regeneration from the leaf of *Atrichum undulatum* (Hedw.) P. Beauv. Trans. Brit. Bryol. Soc. 2: 203-213.

MEYER, S. L. 1942. Physiological studies on mosses, IV. Bot. Gaz. 104: 128-132.

NOGUCHI, A. & I. MIYATA. 1957. Sporelings and regenerants in some mosses. Kumamoto Jour. Sci. Ser. B, Sec. 2, 3: 1-19.

DISCOVERY OF SOLMSIELLA KURZII IN LOUISIANA[1]

RONALD A. PURSELL

Solmsiella kurzii, described by Steere in 1934, has been known only from the type locality, a moist wooded area on the northwestern shore of Lake Miccosukee (about 20 miles northeast of Tallahassee), Jefferson County, Florida, from two collections. The first of these was made in 1927 by Dr. Herman Kurz from the bark of *Magnolia foetida* Sarg. (*M. grandiflora* L.). The second collection, from the bark of the same species, after a lapse of 30 years, was reported by Redfearn in 1957.

On August 4, 1958, while visiting W. D. Reese of Southwestern Louisiana Institute in Lafayette, an excursion was made to Weeks Island, one of the mesophytic, densely wooded salt domes found in the area. While examining the cryptogams on a Magnolia, the trunk of which had been deformed and was growing parallel with and about four feet above the ground, a patch, covering approximately one square inch, of what appeared to be mostly a liverwort and one very small sporophyte was seen. Because of the dense canopy the light was too poor to determine whether the sporophyte was a part of the liverwort-like plant or nothing more

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than an immature capsule of possibly admixed *Clasmatodon*. Later examination in the laboratory, however, showed the gametophytic plants and the sporophyte to be those of *Solmsiella kurzii*.

This collection thus represents the second specimen with a mature sporophyte and the first recognized specimen of the species outside the type locality, increasing its known range westward approximately 500 miles.

Both Steere (1934) and Redfearn (1957) have emphasized that the alleged rareness of *Solmsiella* and other members of the Erpodiaceae may be due to their being overlooked because of the minute size and liverwort-like appearance of the plants. The discovery of *Solmsiella kurzii* in Louisiana greatly increases the possibility of its being found, when carefully searched for, in other mesophytic hardwood stands throughout the Gulf Coastal region.

LOCALITY DATA: On bark of *Magnolia grandiflora*, Weeks Island (salt dome), *ca.* 14 mi. S. of New Iberia, Iberia Parish, Louisiana, August 4, 1958, *R. A. Pursell & W. D. Reese* 3357.

A duplicate of the collection has been deposited in the herbarium of the University of Tennessee.

LITERATURE CITED

REDFEARN, P. L., JR. 1957. Rediscovery of *Solmsiella kurzii*. THE BRYOLOGIST 60: 337-338.

STEERE, W. C. 1934. Notes on the Erpodiaceae of North America, with a description of *Solmsiella kurzii* sp. nov. THE BRYOLOGIST 37: 96-101.

NOTES ON HAWAIIAN HEPATICAE. II. RICCIACEAE[1]

E. B. SCOTT and HARVEY A. MILLER[2]

While vacationing at the Kilauea Military Rest Camp, the senior author collected a number of bryophytes in Hawaii National Park. The *Riccia* specimens were gathered on the Hilina Pali Trail about one-half mile west of the start of the trail at the end of the Hilina Pali Road below Kilauea Crater. Elevation of the collecting site is about 2000 feet. This area lies on the edge of the Kau Desert in the rain-shadow of Kilauea Ridge on Mauna Loa. Strange lava formations abound in this locality including

[1] Notes on Hawaiian Hepaticae. I. Frullaniaceae. 1953. THE BRYOLOGIST 56: 40-48. Grateful acknowledgment is given officials of Hawaii National Park for permission to collect; the Dudley Herbarium for the loan of the Icones Hepaticarum; and T. J. Cobbe, who prepared the habit sketch.

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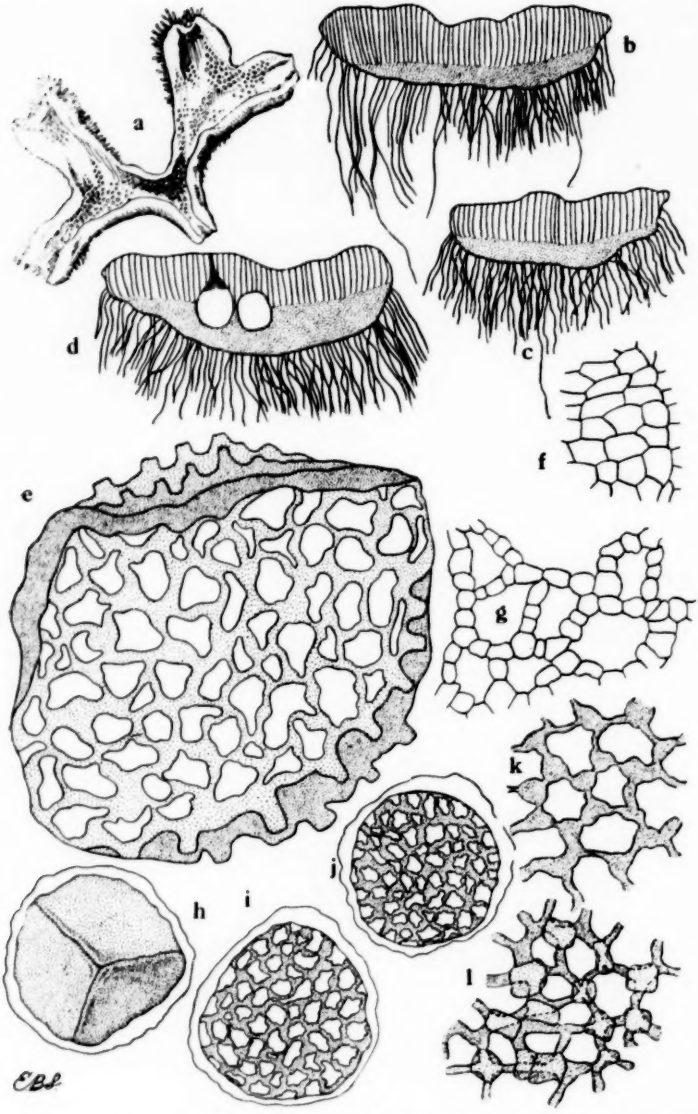

FIG. a-l. *Riccia rechingeri*. a. Habit sketch from a dried specimen, × 6. b, c. Diagrams of transverse sections of the thallus, × 22. d. Diagram of a transverse section of the thallus showing two sporophytes, × 22. e.

several "kipukas," or islands, not covered by the flows. These plants grew in moist earth of the trail and were noted to be so locally abundant that the finder collected only a small portion, not realizing that *Riccia* was previously unknown from the Hawaiian Islands.

We thought at first that our species might be adventive from California and had been introduced by cattle. However, a check of California Ricciaceae indicated that our species was unknown there. Further search indicated that this material could be placed within the rather broad limits of *Riccia rechingeri* Steph. described from Samoa.

Because this is the first report of Ricciaceae from Hawaii, we have prepared a description and drawings of the material studied.

RICCIA RECHINGERI Steph. Sp. Hep. 6: 2. 1917. Thallus in incomplete rosettes, closely adherent to the soil, crystalline, greenish-gray, becoming spongiose with age and vesiculose-alveolate through disorganization of the dorsal epidermis; rhizoids numerous, colorless. Thallus mostly 3.6-6.7 mm. long, thick, usually two times dichotomously branched, terminal segments usually 0.6-2.0 mm. broad when dry, linear-cuneate to linear-obovate with a broad flat channel and thick, raised, slightly convex walls, the apex rounded or emarginate, cilia and ventral scales not seen; the thallus in cross-section mostly from 2.6-4.5 times as broad as thick, broadly channeled above, somewhat convex below, the sides gradually ascending to a slightly recurved margin; air chambers large, epidermal cells more or less rectangular, thin-walled, smooth (disorganized and indistinct in dried material). Monoicous; antheridial ostioles prominent; sporophyte rather deeply immersed, scarcely prominent at maturity; spores reddish-brown, from 72-89 μ in diameter, mostly 79-80 μ, the margin irregularly undulate, the convex face usually with 8-9 areolae across the diameter, areolae to 14 μ in diameter, tuberculate-papillate in profile.

HABITAT: On damp earth in Hilina Pali Trail, Hawaii National Park, Hawaii Island, *E. B. Scott* 7, May 2, 1954 (B. P. Bishop Museum).

Assignment of our material to Euriccia or Ricciella on the basis of the arrangement of chlorophyllous tissue as suggested by MacVicar (1926) presented some problem. Portions of the thallus

Spore, × 815. f. Epidermal cells, × 93. g. Chlorenchyma tissue in transverse section, × 93. h. Diagram of a spore showing inner faces, × 360. i, j. Spores showing convex faces, × 360. k. Portion of the surface of a spore showing areolae and reticulations, × 815. l. Portion of the surface of a spore showing areolae, reticulations and tuberculate projections, × 815. (Figures b-l were drawn with the aid of a camera lucida.)

are distinctly spongiose as in Ricciella (*fig.* g), while elsewhere we found strong suggestions of columnar chlorenchyma (*fig.* b, c, d). We suggest that evaluation of the significance of chlorenchyma morphology would be worthwhile, especially if such studies embrace species from the southern hemisphere.

In the original description, *Riccia rechingeri* is reported to be dioicous. However, we do not consider this to be a serious issue for as MacVicar (1926) indicated, "Antheridia are generally to be found . . . some weeks before the spores are mature; later in the season they may be found only near the apex of the thallus or may have disappeared."

We were impressed by the great abundance of rhizoids in our plants although there is no mention of rhizoids in the original description nor did Stephani illustrate rhizoids in this (*Icones*, 176) or many other species. Perhaps abundance of rhizoids is correlated with the usually xeric habitat as Schuster (1953) suggests.

LITERATURE CITED

MACVICAR, S. M. 1926. Student's Handbook of British Hepatics. Ed. 2. Eastbourne.

SCHUSTER, R. M. 1953. Boreal Hepaticae, a manual of the liverworts of Minnesota and adjacent regions. Amer. Midl. Nat. 49: 257-684.

STEPHANI, F. 1917-1924. Species Hepaticarum. Vol. 6. Geneva.

STEPHANI, JOHANNA. Icones Hepaticarum (msc. tracings of Franz Stephani's unpublished drawings).

THE BRYOPHYTES AND LICHENS OF ONOTOA, GILBERT ISLANDS

EDWIN T. MOUL[1]

The bryophytes and lichens reported here were collected from June 15th to August 30th, 1951, when the author served as general naturalist for the Pacific Science Board Expedition to Onotoa in the Gilbert Islands. The project was supported by funds granted to the National Academy of Sciences by contract N7onr-291(04), Nr 388-001 with the Office of Naval Research.

A detailed report of the geology of the atoll has been made by Cloud (1952). The mosses and liverworts were identified by Dr. H. A. Miller, the blue-green alga by Dr. Francis Drouet and the lichens by Dr. Carrol W. Dodge. The author's collecting number follows each citation. Specimens have been deposited in the U. S.

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National Herbarium, Bernice P. Bishop Museum and the Chrysler Herbarium at Rutgers University.

Onotoa is the most southerly atoll of the Gilbert Islands and is south of the equator (at 1°47′S) and west of the International Date Line (at 175°29′E). The island deposits are unconsolidated calcium carbonate gravels and sands with occasional outcroppings of reef rock (Cloud, 1952). The fresh water forms a lens that floats on the sea water so that fresh water is available to plants, and only during prolonged drought are coconut and breadfruit trees killed by the influx of salt water.

The vegetation of Onotoa reflects the great variability of the annual rain fall. Sachet (1957) has published the available information on the annual rainfall in the Gilbert Islands. The yearly average for Onotoa is 45.8 inches, but there have been years with a total below 20 inches; in 1950 only 5.54 inches of rain were recorded. Drought years appear to be the factor that limits the luxuriance of vegetation and excludes many forms found on wetter atolls and islands. In contrast to the atolls of Majuro in the Marshalls and Big Makin (Butaritari) in the northern Gilberts, the vegetation on Onotoa is less luxuriant. On the two atolls mentioned above the vegetation was lush, and the trunks and branches of trees were covered with epiphytic bryophytes and lichens. Ferns were present on these islands. Bryophytes and lichens were not common on Onotoa, and ferns were missing entirely.

Mosses were growing abundantly on the limesand soil along the lagoon roads. Where paths penetrated particularly dense coconut groves, moss patches were found on limesand soil. All these areas were well shaded. Frequently the patches of moss were surrounded by a thick growth of terrestrial blue-green algae. The black tufts of *Scytonema ocellatum* growing around and mixed with the moss, suggested the presence of a second moss species. However, only one species of moss was found. No liverworts were collected on Onotoa. Dixon (1927) reported *Brachymenium indicum* (Dozy & Molk.) Bry. Jav. as occurring on Onotoa, but this species was not collected by the author. Miller (in correspondence) identified the one species found as *Brachymenium melanothecium* (C. M.) Jaeg. and stated that it is widespread in Oceania.

Bryophytes and lichens were collected at several atolls visited by the expedition on the trip from Kwajalein Atoll in the Marshalls to Onotoa. These records are included in the list of species given below.

Lichens were looked for on Onotoa as the vegetation was being studied and specimens collected. Eight species were found

and collected. These were growing in the areas of dense vegetation. The most luxuriant plant growth was under the *Pisonia* trees on the southernmost island Tabuarorae (Moul, 1957). The greatest number of lichen species were found in this area. Three collections were made from the branches of living *Guettarda speciosa*. Others were found on both living coconut and fallen rotting logs. *Pandanus* and *Morinda citrifolia* also yielded other specimens.

MUSCI

CALYMPERES TENERUM C.M. Marshall Islands, Majuro Atoll, Rogeron Island: Trunk of coconut palm in shaded area, 18 June, 8002; trunk of breadfruit tree, 18 June, 8621. Kwajalein Atoll, Kwadak Island: Base of coconut palm, 17 June, 8001. DISTRIBUTION: This species is widespread in Oceania (Miller & Doty, 1953; Miller & Doty, 1954; Miller, 1955).

CALYMPERES THYRIDIOIDES Broth. Marshall Islands, Majuro Atoll, Uligak Island: On rotten wood in *Scaevola* thickets, 19 June, 8005. DISTRIBUTION: Previously reported from Arno Atoll and other places in the Marshalls as *C. moluccense* (Miller & Doty, 1953).

BRACHYMENIUM MELANOTHECIUM (C. M.) Jaeg. Gilbert Islands, Onotoa Atoll, North Island: On limesand soil in deep shade along roads and paths, July, 8060, 8061, 8095, 8176. South Island: Limesand soil in shade, 23 July, 8213. Tabuarorae: Limesand soil with *Scytonema ocellatum* in deep shade, 25 July, 8241. DISTRIBUTION: Samoa, Tonga, Society Islands, Tuamotu Islands, Kapingamarangi Atoll (Miller & Doty, 1954; Miller, 1956).

HEPATICAE

ARCHILEJEUNEA MARIANA (Gott.) St. Marshall Island, Kwajalein Atoll, Kwadak Island: On the bark of *Pisonia grandis*, common on horizontal branches in the wooded interior of the island, 17 June, 8000. According to Miller (in correspondence) this is a rather depauperate specimen but falls within the range of the species. DISTRIBUTION: Indomalaya and Oceania (Miller, 1956).

HYGROLEJEUNEA VESICATA (Mih.) St. Marshall Island, Majuro Atoll, Rogeron Island: Trunk of a coconut palm, 18 June, 8003. Miller states (1955, in correspondence) that he believes this species belongs in *Cheilolejeunea*. The material from the Marshalls is slightly smaller than the type. Miller believes this may prove to be *C. intertexta*, but further study is necessary. DISTRIBUTION: Samoa, Marshall Islands (Miller, 1955).

LICHENES

ANTHRACOTHECIUM SUBOCHRACEUM (Nyl.) Vainio. Gilbert Islands, Onotoa Atoll, North Island: On the beach rampart from the bark of living *Guettarda speciosa*, growing with *Opegrapha dimidiata*, 8 July, 8070a. South Island: On a fallen coconut tree in the limesilt area, an unusual damp area with a dense growth of young coconuts, 24 July, 8218.

BACIDIA HYPOPTIZA Vainio. Gilbert Islands, Onotoa Atoll, Tabuarorae Island: On trunk of living coconut tree, 25 July, 8238; on the bark of *Morinda citrifolia*, 25 July, 8239. Both collections were made in the grove of *Pisonia grandis*. The vegetation here was the most luxuriant on the island, with the greatest number of plant species present.

BUELLIA LEPTOCLINELLA (Nyl.) Zahlbr. Gilbert Islands, Onotoa Atoll,

North Island: Area of old dune sands at the north end of the island, growing on a rotting coconut log in deep shade, 9 July, 8097.

LECANORA MERRILLII Vainio. Gilbert Islands, Onotoa Atoll, Aonteuma Island: On the bark of living *Guettarda speciosa* in dense shade, 9 July, 8099.

OPEGRAPHA DIMIDIATA Müll. Arg. Gilbert Islands, Onotoa Atoll, North Island: Bark of living *Guettarda speciosa* with *Anthracothecium subochraceum*, 8 July, 8070.

PYXINE CONSOCIANS Vainio. Gilbert Islands, Onotoa Atoll, Tabuarorae Island: On trunk of living coconut tree in *Pisonia* grove, 25 July, 8237.

PYXINE COPELANDII Vainio. Gilbert Islands, Onotoa Atoll, Tabuarorae Island: On trunk of *Pandanus tectorius* in *Pisonia* grove, 25 July, 8235. Big Makin Atoll, Bikati Island: On coconut tree, 21 June, 8006.

PYXINE MICROSPORA Vainio. Gilbert Islands, Onotoa Atoll, Tabuarorae Island: On dead *Pandanus* log in *Pisonia* grove, 25 July, 8236.

LITERATURE CITED

CLOUD, P. E., JR. 1952. Preliminary report on geology and marine environment of Onotoa Atoll, Gilbert Islands. Atoll Research Bull. 12 Pacific Science Board, Washington, D.C.

DIXON, H. N. 1927. Gilbert Island mosses. Jour. Bot. 65: 254-257.

MILLER, H. A. 1955. Bryophytes collected by F. R. Fosberg in the Marshall Islands. Atoll Research Bull. 40. Pacific Science Board, Washington, D.C.

———. 1956. Cryptogams of Kapingamarangi Atoll, Caroline Islands. I. Bryophyta. THE BRYOLOGIST 59: 167-173.

——— & M. S. DOTY. 1953. Bryophytes from Arno Atoll, Marshall Islands. Atoll Research Bull. 25. Pacific Science Board, Washington, D.C.

——— & ———. 1954. Ecological and floristic notes on the Bryophyta of Raroia. *Ibid.* 33.

MOUL, E. T. 1957. Preliminary report on the flora of Onotoa Atoll, Gilbert Islands. Atoll Research Bull. 57. Pacific Science Board, Washington, D. C.

SACHET, MARIE-HELÈNE. 1957. Climate and meterology of the Gilbert Islands. Atoll Research Bull. 60. Pacific Science Board, Washington, D.C.

FRULLANIACEAE OF BURMA. III. FRULLANIA KALAWENSIS N. SP.

RUTH D. SVIHLA[1]

Frullania kalawensis n. sp.[2] Plants medium to small in size,

[1] Dept. of Botany, University of Washington, Seattle 5, Wash. The publication of this work was made possible by a grant from the Biological and Medical Research Fund of the University of Washington.

[2] Planta mediocris ad parvam, glauca ad fusco-viridem; caules ad 1.5 cm. longi, 1 mm. lati, fere 2-3 pinnati multirames. Lobus dorsalis folii ovatus, 825 μ longus, 668 μ latus, trans caulem extendens $\frac{1}{2}$ caulis latitudine, apice rotundato rare decurvo, basi rotundata, margine integerrimo. Lobi ventrales

light to dark green; leafy stem to 1.5 cm. long, 1 mm. wide, compactly bi- to tripinnately branched, rarely with microphyllous branches; branches short, averaging 5 mm. in length; width of main stem averaging 123 μ. Leaves imbricate, spreading at about a right angle. Dorsal leaf lobe ovate, averaging 825 μ long, 668 μ wide; dorsal margin crossing stem to ½ stem width beyond; margin entire; apex rounded, seldom decurved; bases rounded. Ventral leaf lobes all explanate, recurved, about twice as long as wide, averaging ½ the length of the dorsal lobe, 342 μ long, 173 μ wide; apices acute to subacute. First leaf of a branch with 2 explanate lobes. Stylus rare, a row of 3 to 5 cells. Cells of the dorsal leaf lobe at apical margin almost quadrate, averaging 16.4 by 15 μ; median cells nearly isodiametric, averaging 19 by 16 μ; basal cells oval, averaging 31 by 23 μ; all cells with thick walls; trigones and intermediate thickenings few. Underleaves transversely inserted, flat, about twice as wide as the stem, averaging 335 μ long, 246 μ wide, bifid about ⅓ the length; apices acute to subacute; margin entire; a tuft of rhizoids at or below the middle. First underleaf of a branch unlobed. Plant bisexual. Male inflorescences on short lateral branches, subglobose, usually 3 to 8 pairs of bracts, occasionally rejuvenating vegetatively; male bracteole bilobed. Female inflorescences terminal on main stems or branches. Female bracts about ¾ bilobed. Dorsal lobe broadly ovate, averaging 1.1 mm. long, 0.7 mm. wide; apex broadly rounded; margin entire. Ventral lobe recurved, somewhat shorter than the dorsal one, averaging 864 μ long, 600 μ wide; apex acute; margin entire to slightly sinuate. Female bracetole united with the bracts only at the very base, somewhat shorter than the bracts, averaging 755 μ long, 277 μ wide, bilobed ½ to ⅔ its length; lobes broadly lanceolate, narrowed to acute apices; sinus acute to somewhat rounded; margin entire or occasionally with a short tooth near one or both bases. Perianth obovate, exserted ⅓ to ½ its length beyond the bracts, averaging 1.6 mm. long, 1.1 mm. wide, 4-keeled, sometimes with a supplementary dorsal ridge; margin of keels very slightly sinuate when

foliorum omnium explanati, non saccati, 342 μ longi, 173 μ lati, apicibus acutis. Stylus rarus, subulatus, 3-5 cellis continuis. Amphigastria ovata, 335 μ longa, 246 μ lata, caule duplo latiora, ⅓ bilobata, apicibus acutis, sinu acuto. Planta monoica. Folia floralia ¾ bilobata, lobo dorsali 1.1 mm. longo, 0.7 mm. lato, apice obtuso, margine integerrimo, lobo ventrali recurvato, 864 μ longo, 600 μ lato, apice acuto, margine parum sinuato. Amphigastrium florale cum bracteis basi connatum, ½ and ⅔ bilobatum, 754 μ longum, 277 μ latum, lobis lanceolatis, acuminatis, sinu acuto, margine integerrimo ad sinuatum, 1-2 dentibus basi. Perianthium obovatum, 1.6 mm. longum, 1.1 mm. latum, 4-angulatum, margine integerrimo ad sinuatum. Rostrum 77 μ longum, 95.5 μ latum, cellis non papillatis.

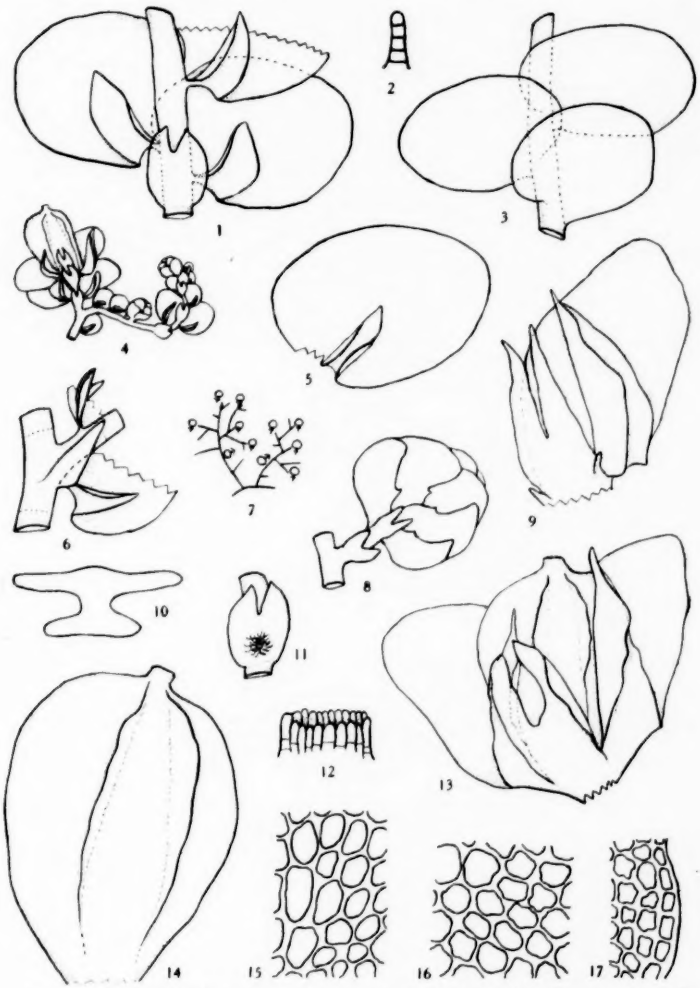

FIG. 1-17. *Frullania kalawensis*. 1. Ventral view of main stem, × 35. 2. Stylus, × 145. 3. Dorsal view of main stem, × 35. 4. Ventral view of plant showing position of male and female inflorescences, × 8. 5. Leaf of main stem, × 35. 6. Ventral view of branch junction, × 35. 7. Scheme of branching. 8. Male inflorescence, × 35. 9. Female bracts, × 35. 10. Cross-section of perianth, × 35. 11. Underleaf, × 35. 12. Beak of perianth, × 145. 13. Young female inflorescence, × 35. 14. Perianth, × 35. 15. Basal cells of dorsal leaf lobe, × 225. 16. Median cells of dorsal leaf lobe, × 225. 17. Marginal cells of dorsal leaf lobe, × 225.

mature. Beak short and broad, averaging 77 μ long, 95.5 μ wide, without papillae. Elaters with 1 spiral, 462 μ long, 15.4 μ wide. Spores light greenish brown, 50.4 by 36 μ.

TYPE: Burma, Southern Shan States, Kalaw, about 3800 ft. elev., on bark of trees, *Svihla* 1594, Apr. 22, 1953 (in herb. University of Washington).

Of the few bisexual species of *Frullania* which have 4-keeled perianths and all the ventral leaf lobes explanate, this one seems to come closest in characters to *F. mayebarae* of Japan. Through the courtesy of Dr. S. Hattori I was able to compare the two species. In *F. kalawensis* the perianth is 4-keeled and sometimes has a low dorsal ridge. *Frullania mayebarae* is 5-angled (with 1 antical fold). The female bracteole of *F. kalawensis* is almost twice as large as that of *F. mayebarae*. The ventral lobe of the female bract is always folded, whereas in the Japanese species the bracts lie flat. The underleaves of *F. kalawensis* are ½ bifid and 1½ times as wide as the stem, whereas in *F. mayebarae* they are ⅓ to ⅖ bifid and only slightly wider than the stem. The dorsal leaf lobes of *F. kalawensis* extend about ½ the stem width beyond the stem; those of *F. mayebarae* extend more than ½ the stem width beyond the stem. The ventral leaf lobes of *F. kalawensis* are about ½ the length of the dorsal lobe, always recurved and with acute apices while those of *F. mayebarae* are about ⅓ the length of the dorsal lobe, lie somewhat flat and have mostly rounded to sometimes truncate apices. The Japanese species is found on wet rocks while the Burmese species grows on the bark of trees.

Stephani (Sp. Hep. 4: 1910) described a bisexual species, *Frullania ubangiensis*, with all explanate ventral leaf lobes, from the Ubangi River in subtropical central Africa. However, in that species the perianth is 5-keeled, the female bracteole and bracts are united and dentate and the underleaves are 4 times the stem width.

FRULLANIACEAE OF BURMA. IV. FRULLANIA MAYMYOENSIS N. SP.

RUTH D. SVIHLA[1]

Frullania maymyoensis n. sp.[2] Plants medium to small in

[1] Dept. of Botany, University of Washington, Seattle 5, Wash. The publication of this work was made possible by a grant from the Biological and Medical Research Fund of the University of Washington.

[2] Planta mediocris ad parvam, glauco-brunnea vel viridis; caules ad 1.5 cm.

size, light brown to green; leafy stem to 1.5 cm. long, about 0.5 mm. wide, 1-3 pinnately branched; primary branches averaging 5 mm. long, secondary branches much shorter; width of main stem about 123 μ. Leaves imbricate, spreading at about a right angle. Dorsal lobe roundish, somewhat concave, wider than long, averaging 631 μ wide, 462 μ long, dorsal margin crossing stem to about ½ stem width beyond; margin entire; apex rounded, sometimes recurved; ventral base rounded, dorsal base rounded to somewhat appendiculate. Ventral leaf lobes saccate, close to stem, rounded, averaging 257 μ wide and long, slightly constricted at or above the wide mouth. First leaf on a branch with only 1 saccate lobe. Stylus very conspicuous, tongue-shaped, almost as long as the ventral leaf lobe, averaging 215 μ long, 61 μ wide at base, 1 cell wide at tip broadening to 4 cells wide at base. Cells of dorsal leaf lobe at margin rectangular, averaging 14.4 by 10.8 μ; median cells oval, averaging 21.6 by 14.4 μ; basal cells oval, large and often colored light brown, averaging 37.8 by 34.2 μ. All cells with some trigones; intermediate thickenings few. Underleaves obovate, transversely inserted, narrowed to base, ½ to ⅓ bilobed, 2 to 2½ times the stem width, averaging 292 μ long, 277 μ wide; margins with 1 or 2 blunt teeth at the widest parts; apices acute to bluntly so; sinus acute; rhizoids in a tuft at or below the middle. First underleaf of a branch usually 2 lobed. Plants bisexual. Male inflorescences subglobose, on short lateral branches, 4 to 8 pairs of bracts; bracteoles bilobed. Female inflorescences terminal on main stem or branch. Female bracts unequally ½ to ⅓ bilobed. Dorsal lobe broadly ovate, concave, averaging 646 μ long by 416 μ wide; apex broadly rounded; margin entire. Ventral lobe usually decurved at tip, averaging 593 μ long by 311 μ wide; apex broadly rounded; upper margin with a large blunt lateral tooth, lower

longi, 0.5 mm. lati, fere 2-3 pinnati, multirames. Lobus dorsalis folii ovatus, 462 μ longus, 631 μ latus, trans caulem extendens ½ caulis latitudine; apice rotundato, rare recurvato; basi rotundato ad appendiculatum; margine integerrimo. Lobus ventralis folii saccatus, late rotundatus, 257 μ longus et latus; ore amplissimo, leviter constricto. Stylus conspicuus, ligulatus, 215 μ longus, 61 μ latus basi; apice unicellulo, basi quadricellulo. Amphigastria obcuneata, 292 μ longa, 277 μ lata, 2 ad 2½ caule latiora, ½ ad ⅓ bilobata; 1 vel 2 dentibus lateralibus in margine; apicibus acutis; sinu acuto. Planta monoica. Folia floralia ½ ad ⅓ bilobata; lobo dorsali late ovato, concavo, 646 μ longo, 416 μ lato, apice rotundatissimo, margine integerrimo; lobo ventrali 593 μ longo, 311 μ lato, apice decurvato et rotundato, margine laterali 1-dentato, margine inferiore sinuato. Amphigastrium florale ovatum, cum 1 bractea connatum, 462 μ longum, 385 μ latum, ⅓ bilobatum, apicibus acutis, sinu acuto ad obtusum; margine superiore 1 vel 2 dentibus lateralibus; margine inferiore sinuato. Perianthium oblongo-pyriforme, 1.1 mm. longum, 847 μ latum, 4-angulatum minoribus jugis interdum additis; rostro latissimo, 100 μ lato, 77 μ longo, cellis elongatis.

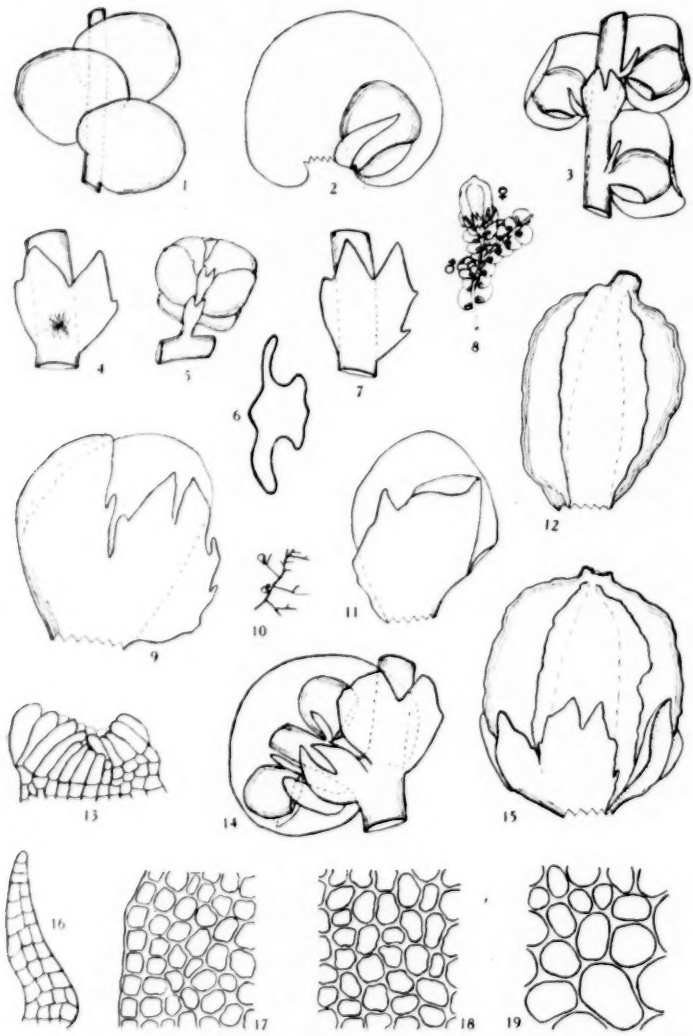

FIG. 1-19. *Frullania maymyoensis*. 1. Dorsal view of plant, × 35. 2. Leaf of main stem, × 45. 3. Ventral view of plant, × 35. 4. Underleaf, × 45. 5. Male inflorescence, × 35. 6. Cross-section of perianth, × 35. 7. Underleaf, × 45. 8. Plant showing male and female inflorescences, × 5. 9. Female bract and bracteole, × 45. 10. Scheme of branching. 11. Female bract, × 45. 12. Perianth, × 35. 13. Perianth beak, × 225. 14. Ventral view of branch junction, × 45. 15. Perianth with involucral leaves, × 35. 16. Stylus, × 145. 17. Marginal leaf cells, × 225. 18. Medial leaf cells, × 225. 19. Basal leaf cells, × 225.

margin somewhat sinuate. Female bracteole ovate, united about ½ its length with 1 bract only, slightly shorter than the bracts, averaging 462 μ long by 385 μ wide; sinus descending about ⅓, acute to obtuse; apices acute; upper margins entire except for 1 or 2 lateral teeth on each side; lower margins sinuate. Perianth oblong-pyriform, smooth, about ½-exserted, averaging 1.1 mm. long by 847 μ wide, rounded or nearly so to the beak, 4-keeled, often with supplementary ridges; margins of keels entire to sinuate. Beak wider than long, averaging 100 μ wide by 77 μ long; cells elongated at the mouth.

HABITAT: Growing on bark of trees mixed with other Hepaticae.

TYPE: Burma, Shan States, Maymyo, Circular Road, 3500 ft. elev., *Svihla* 1312, Nov. 14, 1952 (in herb. University of Washington).

SPECIMENS EXAMINED: All collected by the author at Maymyo in 1952. Government Botanical Garden, 1025b, June 27. Along road near Baptist Mission Rest House, 1071a, July 10. Circular Road, 1110b, 1121a, 1126a, Aug. 9; 1136b, Aug. 14; 1312 (type), Nov. 14. Parkside Road, 1164b, Aug. 29.

Among other species of the subgenus Trachycolea Spruce which are bisexual and have large ligulate styli, this species comes closest to *F. brevicalycina* Steph. (Hedwigia 33: 141. 1894) from St. Kitts, West Indies, and *F. socotrana* Mitt. (Trans. Roy. Soc. Edinb. 31: 335. 1888) from the island of Socotra off the northeastern coast of Africa. However the former species differs from ours in that the perianth is 3-angled with seven smaller plicae and is covered with hooked teeth; also the female bracteole which has setose apices is united with both bracts. The latter species differs from ours in that the perianth is 8-plicate, the ventral leaf lobes are very large and twice as long as wide, the stylus is only one-half the length of the ventral lobe, and the underleaves are scarcely as wide as the stem.

Frullania maymyoensis was found on bark of trees only at Maymyo. It grew with other species of *Frullania* among which was another new species, *F. shanensis*. However *F. shanensis* was also found at other localities in the Shan States (Bryologist 60: 359-363. 1957).

REVIEWS

Hepaticae et Musci URSS Exsiccati, Decas I-V. Edidit Institutum Botanicum nomine V. L. Komarovii Akademiae Scientiarum URSS, curavit L. I. Savicz-Ljubitzkaja. Leningrad. 1957. DECAS I: 1. *Mylia Taylori* (Hook.) Gray. 2. *Schistostega pennata* (H.) Hook. & Tayl. 3. *Cinclidotus fontinaloides* (H.) P.-B. 4. *Schistidium maritimum* (Turn.) Br. & Sch. 5. *Voitia nivalis* Hornsch. 6. *Haplodon wormskioldii* (Hornem) R. Br. 7. *Ulota curvifolia* (Wahl.) Brid. 8. *Pseudoscleropodium purum* (H.) Fl. 9. *Loeskeobryum brevirostre* (Schw.) Fl. 10. *Orthothecium chryseum* (Schw.) BSG. DECAS II: 11. *Sphagnum tenellum* Pers. *ex* Brid. 12. *Dicranum elongatum* f. *longifolium* C. Jens. 13. *Aulacomnium turgidum* (Wahl.) Schw. 14. *Hedwigia ciliata* (H.) P.-B. 15. *Neckera complanata* (H.) Hüb. 16. *Thuidium delicatulum* (H.) Mitt. 17. *Scorpidium scorpioides* f. *longicuspe* C. Jens. 18. *Cirriphyllum piliferum* (H.) Grout. 19. *Pylaisia selwynii* Kindb. 20. *Ptilium crista-castrensis* (H.) DeNot. DECAS III: 21. *Madotheca levigata* (Schrad.) Dum. 22. *Frullania tamarisci* (L.) Dum. 23. *Pogonatum spinulosum* Mitt. 24. *Paludella squarrosa* (H.) Brid. 25. *Meesia triquetra* (Hook. & Tayl.) Ängstr. 26. *Climacium japonicum* Lindb. 27. *Scorpidium turgescens* (T. Jens.) Loeske. 28. *Myuroclada maximowiczii* (Bors.) Steere. 29. *Plagiothecium aomoriense* Besch. 30. *Hylocomium umbratum* (H.) BSG. DECAS IV: 31. *Metzgeria pubescens* (Schrank) Raddi. 32. *Cynodontium strumiferum* (H.) DeNot. 33. *Bartramia pomiformis* var. *crispa.* (Web. & Mohr) Br. & Sch. 34. *Climacium japonicum* Lindb. 35. *Isothecium myosuroides* (Brid.) Brid. 36. *Anomodon attenuatus* (H.) Hüb.; 37. *Myuroclada maximowiczii* (Bors.) Steere. 38. *Scleropodium ornellanum* (Mol.) Mol. 39. *Pterigynandrum filiforme* var. *decipiens* (Web. & Mohr) *Limpr.* 40. *Hylocomium umbratum* (H.) BSG. DECAS V: 41. *Andreaea rupestris* H. 42. *Ditrichum zonatum* (Brid.) Limpr. 43. *Blindia acuta* (H.) Br. & Sch. 44. *Dicranum elatum* Lindb. 45. *Paraleucobryum enervе* (Thed.). Loeske. 46. *Rhacomitrium fasciculare* (H.) Brid. 47. *Lescuraea mutabilis* var. *decipiens* (Limpr.) Mönk. 48. *Hygrohypnum cochlearifolium* (Vent.) Broth. 49. *Hygrohypnum smithii* (Sw.) Broth. 50. *Calliergon trifarium* (Web. & Mohr) Kindb.

Bryologists will welcome the appearance of this series of bryophytes from the USSR. Each Decas is accompanied by a printed catalogue which includes all of the label information and is the work of individual collaborators, as follows: I. L. I. Savicz-Ljubitzkaya; II. Z. N. Smirnova; III. A. L. Abramova; IV. I. I. Abramov; V. R. N. Schljakov. Each Decas is attractively packaged between cardboards with a printed label on the front. Although half of the taxa represented in the exsiccati are widely distributed in the northern hemisphere, and another six have been reported from the southern hemisphere as well, the specimens will nevertheless prove to be of great value. Most American herbaria contain very few, if any specimens from the USSR, and therefore American bryologists are handicapped in any critical study or monographic work beyond that of a local flora. Most persons will be especially pleased to have the two collections of *Myuroclada maximowiczii* just recently added to the known flora of North America. Of special interest, perhaps, are those species not known from America; two European, three Asiatic, and two Eurasian in their geographic distribution.—LEO F. KOCH.

RECENT LITERATURE ON HEPATICS

MARGARET FULFORD[1]

ARNELL, S. List of Hepaticae collected by A. Sörlin in the Seychelles, 1955. Svensk Bot. Tidskr. 51(1): 163-165. 1 *fig.* 1957. [New *Mastigophora africana* n. sp.]

———. Notes on South African Hepaticae V. New species for S. Africa and new localities for little known species. Bot. Not. 110(3): 399-405. 5 *fig.* 1957. [32 spp.; new: *Herberta capensis* (St.) n.c., *Lejeunea letabaensis* n. sp., *Lophocolea fragrans* var. *capensis* n. var., *Marsupella capensis* n. sp., *Plagiochila injasutiensis* n. sp.]

———. Hepaticae collected during Dr. and Mrs. C. Skottsberg's second expedition to the Juan Fernandez Islands, Dec. 1954-March 1955. Arkiv för Bot. 4(1): 1-21. 4 *fig.* 1957. [104 spp.; new: *Jungermannia* (Solenostoma) *obtusiflora* (St.) n. c., *Acromastigum fernandezianse* n. sp., *Schistochila kunkelii* n. sp., *Balantiopsis purpurata* var. *lancifolia* (St.) n.c., *Radula subsquarrosa* n. sp., *Lejeunea fernandeziana* n. sp., *Brachiolejeunea fernandeziana* n. sp., *Phaeoceros skottsbergii* (St.) n. c.]

———. New Hepaticae from Cameroon Mountain. Svensk Bot. Tidskr. 52(1): 63-67. 3 *fig.* 1958. [New: *Cheilolejeunea camerunensis* n. sp., *Tritomaria camerunensis* n. sp., *Cephalozia vaginans* var. *camerunensis* n. var., *Cyclolejeunea annobonensis* Arnell 1956 = *Prionolejeunea kindbergii* St.]

———. New species of *Asterella* and *Riccia* from Sto. Domingo and Cuba. The BRYOLOGIST 61(2): 140-143. 4 *fig.* 1958. [New: *A. dominicensis* n. sp., *Riccia cubensis* n. sp., *R. ekmanii* n. sp.]

BERRIE, G. K. The nucleolar chromosome in Hepatics I. Trans. British Bryol. Soc. 3(3): 421-426. 1 *fig.* 1958.

———. The nucleolar chromosome in Hepatics. II. A phylogenetic speculation. *Ibid.* 3(3): 427-429. 1958.

CASAS DE PUIG, CRUZ. *Exormotheca pustulosa* Mitt. en Port-Bou. Rev. Bryol. et Lichén. 27(½): 17-18. 1 *pl.* 1958.

CASTELL, C. P. New vice-county records. Hepaticae. Trans. British Bryol. Soc. 3(3): 461-470. 1958.

CHAUDEFAUD, M. Sur l'appareil plastidial d'un *Anthoceros*. Bull. Soc. Bot. France 103: 240-247. 6 *fig.* 1956.

CLARK, LOIS. *Frullania gymnotis* found in the United States. THE BRYOLOGIST 61(1): 67. 1958.

———. *Frullania longicollis*. *Ibid.* 61(2): 143-146. 19 *fig.* 1958.

———. *Frullania brenteliana*. *Ibid.* 61(2): 146-149. 16 *fig.* 1958.

———. *Frullania dubia*. *Ibid.* 61(2): 149-151. 13 *fig.* 1958.

———. Hepaticae collected by Svihla near Seward and Fairbanks, Alaska. *Ibid.* 61(2): 152. 1958. [20 spp.]

CRUNDWELL, A. C. (Bryological Notes.) *Riccia rhenana* Lorb. et K. Müll. in Britain. Trans. British Bryol. Soc. 3(3): 449-450. 1958.

FINLAYSON, MARGARET K. Some aspects of the life history of the liverwort *Symphyogyna hymenophyllum* (Hook.) M. et N. Trans. Roy. Soc. New Zealand 78(⅔): 280-290. 39 *fig.* 1950.

FULFORD, MARGARET. The Machris Brazilian Expedition. Botany. Hepaticae. Los Angeles County Museum. Contrib. in Sci. 26: 1-2. 1958. [New: *Microlepidozia verrucosa* (St.) n. c.]

[1] Dept. of Biological Sciences, University of Cincinnati, Cincinnati 21, Ohio.

GREIG-SMITH, P. Notes on Lejeuneaceae. III. The occurrence of hyaline papillae. Trans. British Bryol. Soc. 3(3): 418-421. 4 *fig.* 1958.

GROLLE, R. Über *Jungermannia placophylla* Taylor. Rev. Bryol. et Lichén. 27(½): 52-54. 5 *fig.* 1958. [*J. placophylla* = *Bazzania placophylla* (Tayl.) n. c., from Peru.]

GYÖRFFY, I. Über die Doppelsporen von *Bucegia romanica*, *Sauteria alpina* und *Radula complanata* aus der Hohen-Tatra Nord-Carpathen. Rev. Bryol. et Lichén. 27(½): 38-48. 1 *pl.* 1958.

HALL, G. Notes on the hepatic flora of the Athens [Ohio] area. Ohio Jour. Sci. 58(1): 15-19. 1958. [58 spp.]

HATCHER, R. The genus *Trichocolea* in New Zealand. Trans. Roy. Soc. New Zealand 85(2): 237-246. 3 *fig.* 1958. [New: *T. julacea* n. sp.]

HATTORI, S. Hepaticae of Hokkaido. II. Rishiri and Rebun Islands. Jour. Hattori Bot. Lab. 18: 78-92. 1957. [New: *Bazzania denudata* ssp. *ovifolia* (St.) n. c. et n. stat., *Calypogeia* subgen. Metacalypogeia subgen. n., *C. tosana* var. *septentrionalis* n. v., *Solenostoma exsertifolium* (St.) Amakawa n. c., *Lejeunea auriculata* (St.) n. c.]

———. Hepaticae of Hayachine mountain with special reference to Hepaticae occurring on serpentine rocks. *Ibid.* 18: 106-118. 1957. [New: *Cheilolejeunea obtusifolia* (St.) n. c., *C. ontakensis* (St.) n. c.]

——— & H. INOUE. *Takakia lepidozioides*. Preliminary report on *Takakia lepidozioides*. *Ibid.* 19: 133-137. 24 fig. 1958. [New gen. & sp.]

——— & M. MIZUTANI. A revision of the Japanese species of the family Lepidoziaceae. *Ibid.* 19: 76-118. 28 *fig. maps* a-g. 1958. [New: *Bazzania mayebarae* Hatt. n. sp.]

HERING, E. M. Minierfliegen in Lebermoosen (Dipt. Agromyzidae). Mitt. Deutsch. Entomolog. Gesell. 16: 48-51. 1957.

HERZOG, T. Die Lebermoose Europas (Musci hepatici). *In* Rabenhorst's Kryptogamen-Flora. VI. Aufl. 3. Lief. 9: 1221-1365. *Fig.* 473-514. 1957. [The family Anthocerotaceae is by J. Proskauer; new: *Frullania nervosa* var. *microcellularis* K. Müller n. v., *Lejeunea Mandoni* (St.) Herz. n. c., *Anthoceros necsii* Proskauer stat. et nom. nov.]

———. Lebermoose aus Ecuador gesammelt von Dr. E. Asplund. Svensk. Bot. Tidskr. 51(1): 187-196. 7 *fig.* 1957. [New: *Metzgeria violacea* var. *dorsipara* n. v., *Calypogeia oblata* n. sp., *Brachiolejeunea appendiculata* var. *bifida* n. var., *B. Asplundii* n. sp., *Harpalejeunea cinchonae* var. *strigulosa* n. var., *H. longilobula* n. sp., *H. subvittata* n. sp., *Drepanolejeunea andina* n. sp.]

IKEYAMI, Y. On *Pleurozia purpurea* in Japan and Formosa. Jour. Hattori Bot. Lab. 18: 65-69. 2 *fig.* 1957.

INOUE, H. Studies on spore germination of Hepaticae. 2. *Wiesnerella denudata* (Mitten) Steph. Jour. Hattori Bot. Lab. 18: 102-105. 21 *fig.* 1957.

———. Studies on spore germination of Hepaticae. (3). Jour. Jap. Bot. 33(1): 6-11. 10 *fig.* 1958. [Germination in *Brachiolejeunea sandvicensis* and *Frullania hamatiloba*.]

IVERSON, GRACE. Pure culture of *Frullania*. THE BRYOLOGIST 60(4): 348-358. 8 *fig.* 1957.

JELENC, F. Les bryophytes nord-africains. IV. Le genre *Riella* en Afrique méditerranéenne et au Sahara. Rev. Bryol. et Lichén. 26(½): 20-50. 6 *fig. maps.* 1957.

JONES, E. W. An annotated list of British Hepatics. Trans. British Bryol. Soc. 3(3): 353-374. 1958.

———. African hepatics. XIV. Some Cephaloziellas of lowland tropical Africa. *Ibid.* 3(3): 430-440. 5 *fig.* 1958. [New: *Cephaloziella ugandica* n. sp., *C. nigerica* n. sp., *C. gittinsii* n. sp., *C. retusa* n. sp.]

JOVET-AST, SUZANNE. Hépatiques du Surinam. Acta Bot. Neerlandica 6: 602-608. 1957.

———. Quatre *Riccia* des Petites Antilles. Rev. Bryol. et Lichén. 26(¾): 177-186. 3 *fig.* 1957 (1958).

———. Localites nouvelles de diverses espèces du genre *Colura*. *Ibid.* 27(½): 19-23. 1958. [San Thomé, Madagascar, Île de la Réunion, Pén. Malaise, Sumatra, Bornéo, Philippines, Surinam.]

———. Hépatiques du Cambodge récoltées par le Professeur Roger Heim. *Ibid.* 27(½): 24-30. 1 *fig.* 1958. [New: *Colura fastigata* n. sp.; 25 spp.]

KACHROO, P. *Schusteria*, a new genus of Lejeuneaceae. THE BRYOLOGIST 60(3): 273-277. 14 *fig.* 1957. [New: *Schusteria* n. gen., *S. tonduzana* (St.) n. c.]

———. Morphology of Rebouliaceae. III. Development of sex organs, sporogonium and interrelationships of the various genera. Jour. Hatteri Bot. Lab. 19: 1-24. *Fig.* 1-92. 1958. [New: *Asterella angusta* (St.) n. c., *A. blumeana* (Nees) n. c., *A. multiflora* (St.) n. c., *A. mussuriensis* (Kashyap) n. c., *A. nepalensis* (Taylor) n. c., *A. papulosa* (St.) n. c., *A. parvipora* (St.), *A. pathankotensis* (Kashyap) n. c., *A. reticulata* (Kashyap) n. c., *A. sanguinea* (L. et L.) n. c., *Mannia indica* (St.) n. c., *Asterella reticulata Evans* = *A. evansii* Kachroo n. sp.]

KEIL, M. *Fimbriaria Lindenbergiana* Corda a *Clevea hyalina* (Somm.) Lindberg v Tatrách. Preslia 30(1): 88-89. 1958.

KING, A. L. KATHLEEN. The hepatic *Ptilidium pulcherrimum* (Web.) Hampe new to Ireland. Irish Nat. Jour. 11: 205. 1954.

KNAPP, E. & E. MÖLLER. Tetradenanalytische Auswertung eines 3-Punktversuchs bei *Sphaerocarpus donnellii* Aust. Zeitschr. f. indukt. Abstamm. u. Vererb. 87: 298-310. 3 *fig.* 1957.

KUCYNIAK, J. A boreal liverwort of rare occurrence new to North America: *Scapania crassiretis*. Svensk Bot. Tidskr. 52(1): 68-72. 1 *fig.* 1958.

LUISIER, A. Recherches bryologiques récentes à Madère. 6. Broteria 22(4): 178-191. 1953.

MEHRA, P. N. A new suggestion on the origin of thallus in the Marchantiales. I. The thallus structure. Amer. Jour. Bot. 44(6): 505-513. 18 *fig.* 1957.

———. A new suggestion in the origin of thallus in the Marchantiales. II. The Theory. *Ibid.* 44(7): 573-581. 12 *fig.* 1 *tab.* 1957.

MEIJER, W. Notes on some Malayan species of *Anthoceros* L. (Hepaticae) —II. Jour. Hattori Bot. Lab. 18: 1-13. 5 *pl.* 1957. [10 spp., new: *Anthoceros hirticalyx* (St.) n. c., *A. megasporus* n. sp.]

MIZUTANI, M. & S. HATTORI. An etude on the systematics of Japanese Riccardias. Jour. Hattori Bot. Lab. 18: 27-64. *Fig.* I-XII. 1957. [Keys and descriptions; new: *Riccardia* subgen. Trichostylium (Corda) n. stat., *R.* subgen. Lobatiriccardia n. subgen., *R. nana* n. sp., *R. kodamae* n. sp.]

PROSKAUER, J. Nachtrag zur Familie Anthocerotaceae. See Herzog, T. 1957.

ROUSSEAU, JACQUELINE. Action de la coumarine sur la germination des spores de *Marchantia polymorpha* L. Bull. Soc. Bot. France 104(5/6): 255-256. 5 *fig.* 1957.

Schuster, R. M. Notes on nearctic Hepaticae. XI. A study of *Plagiochila yokogurensis* Steph. Jour. Hattori Bot. Lab. 18: 14-26. 4 *fig.* 1957. [New: *P. yokogurensis* ssp. *fragilifolia*, n. ssp., now recognized from Washington, D.C., North Carolina, Virginia, South Carolina.]

———. Boreal Hepaticae, a manual of the liverworts of Minnesota and adjacent regions. II. Ecology. Amer. Midland Nat. 57: 203-256; 257-299. 1957.

———. North American Lejeuneaceae. VI. *Lejeunea:* introduction and keys; subgenus Lejeunea (1). Jour. Elisha Mitchell Sci. Soc. 73(1): 122-197. *Fig.* 25-34. 1957. [New: *L. flava* ssp. *orientalis* n. ssp., ssp. *moorei* (Ldbg.) n. c., *L. lamacerina* ssp. *gemminata* n. ssp.]

———. Annotated key to the orders, families and genera of Hepaticae of America north of Mexico. The Bryologist 61(1): 1-66. 7 *fig.* 1958. [New: *Trichostylium pinguis* (L.) n. c., T. *pellioides* (Horik.) *T. lobata* (Schiffn.) n. c., *Sphaerocarpus tuberosus* (Camph.) n. c.]

———. Notes on nearctic Hepaticae. XV. *Herberta.* Rev. Bryol. et Lichén. 26(3/4): 123-145. 5 *fig.* 1957 (1958). [New: *H. sakuraii* spp. *hutchinsiae* (G. ex Evs.) n. c., and ssp. *tenuis* (Evs.) n. c.]

Segawa, M. Zytologische Untersuchungen bei *Anthoceros laevis* mit besonderer Rücksicht auf seinen Nukleolinus Chromosom. Jap. Jour. Genetics 36: 93-96. 1956.

Stange, Luise. Untersuchungen über Umstimmungs- und Differenzierungsvorgänge in regenerierenden Zellen des Lebermooses *Riella.* Zeitschr. f. Bot. 45(3/4): 197-244. 26 *Abb.* 1957.

———. Weitere Untersuchungen über den Einfluss von Indolylessigsäure auf die Vorgänge in regenerierenden Zellen des Lebermooses *Riella. Ibid.* 46(2/3): 199-208. 2 *Abb.* 1958.

Szweykowski, J. [New records of hepatics in Poland.] Sprawozdan. Pozn. Tow. Przyj. Nauk I-II: 118-119. 1956.

———. Liverworts of the Tatra Mountains—a brief account of the actual state of research. Acta Soc. Bot. Poloniae 26(4): 757-784. 1957. [English summary.]

———. *Metzgeria simplex* Lorbeer found in Poland. Comm. Poznan Soc. Friends of Science. Sect. Math. et Nat. Sci. I. 2 pp. *Figures.* 1958.

Tatuno, S. Zytologische Untersuchungen über die Lebermoose. Jap. Jour. Genetics 31: 334-341. 1956.

Thompson, S. Possible *Scapania paludosa* in Co. Kerry. Irish Nat. Jour. 11(1): 21. 1953.

Vanden Berghen, C. Le Genre *Marchantia* L. au Congo Belge. Jard. Bot. de l'État Bull. 24(1): 37-50. *Fig.* 3-7. 1954.

———. Bryophytes (Hepaticae). *In* Robyns, Flore Générale de Belgique. 1(3): 271-389. *Fig.* 86-125. 1957. [This completes the Hepaticae; an excellent manual with keys, descriptions, localities, etc.]

Wolfe, F. T. Comparative chlorophyll content of the two generations of bryophytes. Nature 181: 579-580. 1958. [*Anthoceros carolinianus, Polytrichum commune, Dicranum scoparium.*]

RECENT LITERATURE ON LICHENS—28[1]

WILLIAM L. CULBERSON[2]

BESCHEL, R. Flechtenvereine der Städte, Stadtflechten und ihr Wachstum. Ber. Naturwiss.-Med. Ver. in Innsbruck 52: 1-158. *69 fig.* 18 *tab.* (1957-1958) 1958.

BIBBY, P. & G. G. SMITH. A list of lichens of western Australia. Jour. Roy. Soc. Western Australia 39: [2 pp.] 1954. [36 spp.]

CULBERSON, W. L. The chemical strains of the lichen *Parmelia cetrarioides* Del. in North America. ΦYTON [Vincent López (Bs. As.), Argentina] 11(1): 85-92. *7 fig.* 1958.

DIX, W. L. On *Anaptychia leucomelaena* fo. *filiformis*. THE BRYOLOGIST 61(2): 153. 1958.

DUTILLY, A., E. LEPAGE, M. DUMAN. Contribution à la flore des iles (T.N.O.) et du versant oriental (Qué.) de la Baie James. Contrib. Arctic Inst. [Catholic Univ. of Amer.] No. 9F: 1-199. 15 *fig.* 1958. [3 lichens, p. 18.]

ESCHRICH, W. Über Parietinsäure, eine neuen Inhaltsstoff der gelben Wandflechte *Xanthoria parietina* (L.) Th. Fr. Biochem. Zeitschr. 330: 73-78. *2 fig.* 1958.

FOSTER, A. B. & M. STACEY. The polysaccharides from lower plants such as bacteria, algae, fungi and lichens etc., and their related enzymes. Handbuch der Pflanzenphysiol. 6: 331-344. 1958. [Lichens, pp. 337-338.]

GALINOU [=LETROUIT-GALINOU], M[ARIE]-A[GNÈS]. Sur la mise en évidence de quelques bio-catalyseurs chez les lichens. 8ème Congr. Internatl. Bot., Rapp. & Comm. Sects. 18-20 [Paris]. Pp. 2-4. 1954. [Abstract.]

HALE, M. E. JR. Vitamin requirements of three lichen fungi. Bull. Torrey Bot. Club 85(3): 182-187. *3 fig.* 1958. [On *Acarospora fuscata* (Nyl.) Arn., *Buellia stillingiana* Steiner and *Sarcogyne similis* Magn.]

HALICZ, B. Notices lichénologiques concernant le Plateau de Łódź. Bull. Soc. Sci. et Lett. de Łódź. Cl. III Sci. Math. et. Nat. 9(2): [7 pp.] 1 *tab.* 1958. [158 spp.]

JAMES, P. W. Notes on the collection and preservation of lichens. The Lichenologist 1(1): 41-45. 1958.

KILPIÖ, O. Iakttagelser över den antibakteriella effekten hos ett usninsyraderivat (Usno) och den kliniska användningen av detta vid pyodermifall. [Observations on the antibacterial effect of an usnic acid derivative (Usno) and its clinical use in the pyodermas.] Nord. Hyg. Tidskr. 37: 289-294. *2 fig.* 1956. [". . . a high degree of activity against a number of micro-organisms including gram-positive and gram-negative bacteria and fungi."—English summary.]

KLEMENT, O. *Parmelia mougeotii* Schaer. im Naturschutzgebiet Romberg bei Lohr/M. und ihre Verbreitung in Europa. Nachr. des Naturwiss. Mus. der Stadt Aschaffenburg Heft 58: 39-47. *Pl. 2.* 1958.

———. Zur Flechtenvegetation der Kalkheiden im Main-Gebiet. *Ibid.* Heft 58: 49-58. 1958. [36 spp.]

[LÄÄKE OY PHARMACEUTICAL CO., Turku, Finland.] Usno, a present to the the world from the North! A new effective antibiotic manufactured from

[1] Names of new taxa from the Americas are marked with an asterisk (*).

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reindeer lichen! 4 pp. *Illus.* n.d. [1957?]. [Commercial brochure describing Usno.]

[———.] Usno, un remède antibiotique, préparé d'une matière première finlandaise, le lichen des rennes. 4 pp. n.d. [1958?]. [Commercial brochure describing Usno.]

LAMPE, W. & O. KLEMENT. Die Flechtenvegetation zwischen Oker und Leine im Raume von Hildesheim bis zum Harzrand. Zeitschr. des Mus. zu Hildesheim, N.F. 12: 1-77. 3 *pl.* 1 *map.* 1958. [204 spp.; notes on the vegetation.]

LAUNDON, J. R. Lichens new to the British flora: I. The Lichenologist 1(1): 31-38. 1958. [7 spp. Keys to the *Cladonia furcata* and *Lecanora expallens* groups in Britain.]

———. The lichen vegetation of Bookham Common. London Nat. 1957: 66-79. 1 *map.* (1957) 1958. [About 75 spp. with notes on the vegetation. Keys to the *Lecanora dispersa* and *Cladonia pyxidata-fimbriata* groups. New: *L. dispersa* f. *albescens* (Hoffm.) n. c., *Ochrolechia turneri* (Sm.) n. c.]

LEPAGE, E. Premier supplément au catalogue des lichens du Québec. Nat. Canad. 85: 169-198. 1958. [About 325 taxa.]

LETROUIT-GALINOU, M[ARIE]-A[GNÈS]. Revision monographique du genre *Laurera* (Lichens, Trypéthéliacées). Supplément I. Rev. Bryol. et Lichén. 27(1-2): 66-73. 10 *fig.* 1958. [New: *L. megasperma* f. *conica* n. f., *L. santessoni* n. sp., *L. dodgei** n. sp.]

PAASIO, I. Pieni Jäkälä- ja Sammalkirja. 96 pp. 24 *cuts with 222 fig.* Kustannusosakeyhtiö Otava. Helsinki. 1950. [Keys and descriptions for many common macrolichens and bryophytes. In Finnish.]

PACLT, J. Farbenbestimmung in der Biologie. vii + 76 pp. 22 *fig.* 5 *pl.* VEB Gustav Fischer Verlag. Jena. 1958. Price: DM 18.70. [Color photograph of a ferrous limestone coating produced by a lichen: fig. 13, p. 18.]

PIŠÚT, I. Príspevok k poznaniu lišajníkov Slovenska. [Beitrag zu der Kenntnis der Flechten der Slowakei.] Acta Fac. Rerum Nat. Univ. Comenianae, Bot. 2(7-9): 377-380. 1958. [28 taxa.]

POELT, J. Lichenes Alpium et Regionum Confinium. Fasc. I. 7 pp. Kryptogamen-Abteilung der Botanischen Staatssammlung München. 1956. [Labels for nos. 1-20 in this exsiccat.]

———. Mitteleuropäische Flechten V. Mitteil. der Bot. Staatssammlung München 1957(17-18): 386-399. 1957. [38 spp. New: *Toninia kolax* n. sp., *Lecanora sarcopisoides* v. *hypnophaga* n. v., *Protoblastenia calva* v. *lacta* n. v.]

———. Über parasitische Flechten. II. Planta 51: 288-307. 11 *fig.* 1958. [60 spp. New: *Caloplaca anchon-phoeniceon* Poelt & Clauzade n. sp., *C. insularis* n. sp., *C. magni-filii* n. sp., *C. necator* Poelt & Clauzade n. sp., *Lecidea (?) percutiens* n. sp., *Rhizocarpon renneri* n. sp.]

[POPNIKOLOV, A.] [Flechten von Ost- (Griechisch) Mazedonien.] [Bulgar. Akad. na Nauk., Izv. na Bot. Inst.] [= Acad. Bulgare des Sci., Bull. de l'Inst. Bot.] 4: 353-356. 1955. [53 spp. In Bulgarian, German and Russian summaries.]

RUSH, J. H. Mars—our next of kin. Duke Univ. Alumni Register 44(3): 8-10. *Illus.* 1958. [A selection from "The Dawn of Life" (1958) by the same author; concerning the possibility of a lichen-like vegetation on Mars.]

[SHIBATA, S.] [Some aspects of the products of lichen and fungi.] [Kagaku-no-Ryoiki] [Tokyo] 5(10) : 574-584. 1 *portrait* [of *Y. Asahina*]. 1951. [In Japanese.]

SKYE, E. Luftföroreningars inverkan på busk- och bladlavfloran kring skifferoljeverket i Närkes Kvarntorp. [The influence of air pollution on the fruticose and foliose lichen flora around the shale-oil works at Kvarntorp in the province of Närke.] Svensk Bot. Tidskr. 52(1) : 133-190. 11 *fig.* 28 *maps.* 6 *tab.* 1958. [Many spp.]

SOCIEDAD DE CIENCIAS NATURALES LA SALLE. El Archipiélago de Los Roques y La Orchila. 257 pp. *Illus.* Editorial y Fotograbado Sucre. Caracas. 1956. [Photograph and mention of orchil (*Roccella* spp.) : pp. 43, 63, 66.]

SOWTER, F. A. The lichens of Jan Mayen Island. Rev. Bryol. et Lichén. 27(1-2) : 74-81. 1958. [75 taxa.]

STEIN VON KAMIENSKI, E. Untersuchungen über die flüchtigen Amine der Pflanzen. III. Mitteilung. Die Amine von Pilzen. Planta 50 : 331-352. 8 *fig.* 8 *tab.* 1958. [*Sticta* spp., p. 340.]

STEINER, M. Die Fette der Pilze. Handbuch der Pflanzenphysiol. 7 : 59-89. 17 *tab.* 1957. ["Lichenisierte Pilze (Flechten)," p. 81.]

———. Rindenepiphyten als Indikatoren des Stadtklimas. Pp. 119-124, *fig.* 244-252 *in* P. Vogler & E. Kühn (editors), "Medizin und Stätebau, ein Handbuch für Gesundheitlichen Stätebau." Urban & Schwarzenberg. München-Berlin-Wien. 1957. [Corticolous lichens in Bonn.]

SWINSCOW, T. D. V. An arctic-alpine lichen new to England. The Lichenologist 1(1) : 29-30. 1958. [*Hypogymnia alpicola* (Th. Fr.) Wats.]

SZATALA, Ö. Prodromus einer Flechtenflora des Irans. Ann. Hist. Nat. Mus. Natl. Hungarici, ser. nov. 8 : 101-154. 1957. [248 spp. Keys. New : *Lecidea euphorea* f. *decussata* n. f., *Gasparrinia biatorina* v. *centrifuga* n. v.]

TALLIS, J. H. The British species of the genus *Cladonia*. The Lichenologist 1(1) : 3-20. 1958. [A key.]

TANSLEY, A. G. The British Islands and Their Vegetation. In 2 vol. xxxviii + xxviii + 930 pp. 179 *fig.* 162 *pl.* Cambridge University Press. 1953 [3rd impression of the new (1949) issue.] [Many references to lichens and bryophytes.]

THOMSON, J. W. & E. H. KETCHLEDGE. The 1957 forays of the American Bryological Society on the Santa Cruz Peninsula, California. THE BRYOLOGIST 61(2) : 155-161. 1 *fig.* 1958. [Many lichens.]

TOBOLEWSKI, Z. Zielnik Porostów Polski. Fasc. IX Nr 176-200. Porosty Pienin. [Lichenotheca Polonica. Fasc. IX. Nr 176-200. Lichenes in Montibus Pieniny Collecti.] 8 pp. (Acad. Sci. Polon.). Poznań. 1957. [Labels for nos. 176-200 in this exsiccat.]

VĚZDA, A. Lichenes Bohemoslovakiae Exsiccati, Editi ab Instituto Botanico Universitatis Agriculturae et Silviculturae, Brno, ČSR. Fasciculus VII. Dec. 19-21. (1958). 8 pp. [Labels for nos. 181-210 in this exsiccat.]

———. Lichenes Bohemoslovakiae Exsiccati, editi ab Instituto Universitatis agriculturae et silviculturae Brno, Zemědělská 3. Sborn. Vysoké Školy Zemědělské a Lesnické v Brně 1958(2) : [1 p.] 1958. [List of herbaria receiving this exsiccat.]

VIRTANEN, O. E. Uusimmista usniinihappotukimuksista. Lääke-Uutiset 24-25 : [6 pp.] 1955.

——— & N. KÄRKI. On the toxicity of an usnic acid preparation with the

trade name Usno. Suomen Kemistilehti B *29*: 225-226. 1 *fig.* 1 *tab.* 1956.

——— & P. Niemi. A reaction product of usnic acid with sulfaguanidine and n-methyl-l-glucosamine. *Ibid.* B *28*: 71. 1955. [". . . moderately active against *Mycobacterium tuberculosis* var. *hominis* . . ."]

———, Maija-Leena Vähätalo & A. E. Kortekangas. Usnic acid derivative of 4-amino-3-isoxazolidone (Cycloserine). *Ibid.* B *29*: 30-31. 1 *tab.* 1956. [A new chemotherapeutic substance.]

Wachtmeister, C. A. Studies on the chemistry of lichens. XI. Structure of picrolichenic acid. Acta Chem. Scand. *12*(2): 147-164. 6 *fig.* 1958. [From *Pertusaria amara* (Ach.) Nyl.]

Wade, A. E. The British species of *Collema*. The Lichenologist 1(1): 21-29. 1958. [A key.]

———. *Cetraria islandica* (L.) Ach. var. *tenuifolia* (Retc) [*sic*] Wain.—*C. crispa* (Ach.) Nyl. *Ibid.* 1(1): 40. 1958.

———. *Gyrophora hirsuta* new to British Isles. *Ibid.* 1(1): 39-40. 1958.

———. Lichens of Carmarthenshire, South Wales. Rev. Bryol. et Lichén. *27*(1-2): 82-103. *2 tab.* 1958. [Many taxa.]

Young, E. G. Carbohydrate accumulation by lower plants. Handbuch der Pflanzenphysiol. *6*: 909-923. *2 tab.* 1958. [Lichens and bryophytes, pp. 917-918.]

[Zhelezova, B.] [Beitrag zur Flechtenflora Bulgariens.] [Bulgar. Akad. na Nauk., Izv. na Bot. Inst.] [= Acad. des Sci. de Bulgarie, Bull. de l'Inst. Bot.] 5: 387-404. 1956. [130 spp. In Bulgarian, German and Russian summaries.]

[———.] [The wolf lichen]—*Letharia vulpina* (L.). Vain. [Priroda, Nauchno-Populiaren Dvumesechńik za Estestveno-Istoricheski Zhaniia] [Sofia] 1956(1): 66-68. *2 fig.* 1956. [Map of the distribution in Europe. In Bulgarian.]

[———.] [Lichens as a source of antibiotic substances.] *Ibid.* 1957(3): 76-81. 5 *fig.* 1957. [In Bulgarian.]

NEWS AND NOTES

A Correction.—In a paper entitled "Notes on *Cladonia*, subgenus Clathrina" published in Vol. 61, No. 1, pp. 48-81, Nylander's original name for what Müller Argov later changed to *Clathrina* appears as *Cladina* instead of *Cladia*. Müller made the change because of the existence of *Cladium* a genus of sedge, a name which was regarded by him as too close to *Cladia*.

Duvigneaud regarded the members of Nylander's genus as possessing pseudopodetia of thalline origin and structure, and this, rather than the absence of a primary thallus, was doubtless his main reason for segregating the species concerned into a separate genus and family.

Carroll W. Dodge, in his account of the lichens collected by members of the B.A.N.Z. Antarctic Research Expedition of 1929-1931 under the leadership of Sir Douglas Mawson, retains the genus *Cladia* as distinct from *Cladonia*, and in his key distinguishing them states that the primary thallus of *Cladia* is "crustose and evanescent or unknown." I am unaware of the evidence for the statement, the primary thallus of *Cladonia retipora* being distinctly squamulose.—William Martin.

The second issue of the *Index to Plant Chromosome Numbers*, compiled from nearly 300 journals published in 1957, is now ready for dis-

tribution. There are about 2000 listings of original chromosome counts from the entire plant kingdom and a bibliography of 196 papers from which the listings were taken. The price of each issue is $1.00. Orders may be sent to Dr. C. Ritchie Bell, Dept. of Botany, University of North Carolina, Chapel Hill, N. C.

Duke University has just purchased the lichenological library of Henry Willey (1824-1907)—pioneer American lichenologist, friend and colleague of Edward Tuckerman, and editor of the "New Bedford [Mass.] Standard." The collection, about 15,000 pages distributed among some 450 items, contains the major lichenological publications of the second half of the nineteenth century and autographed correspondences.

Volume 1, part 1 of *The Lichenologist* was recently published by the British Lichen Society. (My copy was postmarked September 16.—HAC.) For a time the journal will be largely instructive. This issue includes keys to British species of *Cladonia* and *Collema*, notes on collection and preservation of specimens, information on standard chemical tests, etc. The papers are cited in the "Recent literature on lichens" in this issue of THE BRYOLOGIST, and further information on the new society can be found in the March 1958 number of THE BRYOLOGIST.

DR. ÖDÖN SZATALA, lichenologist at the Természettudományi Múzeum (Budapest), died of cancer on June 27, 1958. Although best known for his studies on the Hungarian flora upon which he was just finishing a book, Dr. Szatala also published widely on the lichens of Asia Minor.

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